

Customer Action Program Measurement and Verification Report 2018

Prepared for the FirstEnergy Ohio Companies:

*Ohio Edison Company
The Cleveland Electric Illuminating Company
The Toledo Edison Company*

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1 Executive Summary

For 2018, the Ohio Operating Companies, The Cleveland Electric Illuminating Company (CEI), Ohio Edison Company (OE), and The Toledo Edison Company (TE) (collectively “Companies”) offered the Customer Action Program (“CAP”). The CAP captures energy savings and peak demand reductions achieved through actions taken by customers outside of utility-administered programs pursuant to R.C. 4928.662. Under this Revised Code section, the operating companies are authorized to count toward the benchmarks energy efficiency savings and peak demand reductions that are: (1) achieved through customer actions that comply with federal standards, including resources recognized as capacity resources by PJM Interconnection, L.L.C.; (2) achieved since 2006, measured on the higher of an as found or deemed basis; and (3) for new construction, counted based on 2008 federal standards.

Under contract with the Companies, ADM Associates, Inc. (ADM) performed evaluation, measurement, and verification (EM&V) activities for the CAP. The procedures used to perform the EM&V activities described in this report were informed by the approved State of Ohio Energy Efficiency Technical Reference Manual (“TRM”)¹ and ADM’s previous experience performing EM&V activities for the Companies’ DSM programs. In addition, the procedures chosen built on information collected during a project initiation meeting and succeeding discussions with the Companies’ staff.

The evaluation effort was accomplished by employing a variety of approaches to capture customer and market information, which included surveying efforts; market research; reports from retailers, administrators and trade allies; site verification visits; removal of potential cross participation from 2018 EE programs; and other evaluation, measurement and verification activities.

1.1 Residential

ADM employed varying evaluation strategies in performing an impact evaluation of the residential measures of the CAP. There were four residential measure categories investigated in the evaluation: Lighting, Appliances, HVAC and Consumer Electronics.

For each measure, ADM employed two strategies:

- A bottom-up approach utilizing primary data collected from the Companies’ service territories via an online survey and field verification visits.
- A top-down approach utilizing macro-level data sources where available.

¹ Vermont Energy Investment Corporation (VEIC), *State of Ohio Energy Efficiency Technical Reference Manual*, Prepared for Public Utilities Commission of Ohio, Draft of August 6, 2010, Revised, September 30, 2013.

Table 1-1 breaks out the analysis approach used to estimate ex-post savings by measure and the approach used to corroborate the results.

Table 1-1: Ex-Post Analysis Approach and Secondary Approach by Measure

Program	Measure	Ex-Post Approach	Secondary Approach	Validation Sources
HVAC	Heat Pump	Top-Down	Bottom-Up	AHRI Sales Data / Field Verification
	Air Conditioner	Top-Down	Bottom-Up	AHRI Sales Data / Field Verification
	Room Air Conditioner	Top-Down	Bottom-Up	AHRI Sales Data / Field Verification
	Dehumidifier	Bottom-Up	Top-Down	Field Verification / AHAM Shipping Report
Refrigeration	Refrigerator	Bottom-Up	Top-Down	Field Verification / AHAM Shipping Report
	Freezer	Bottom-Up	Top-Down	Field Verification / AHAM Shipping Report
Lighting	Lamps	Bottom-Up	Top-Down	Field Verification
Consumer Electronics	Computer	Bottom-Up	Top-Down	Energy Star Shipping Report
	Computer Monitor	Bottom-Up	Top-Down	Energy Star Shipping Report
	Imaging and Printing	Bottom-Up	Top-Down	Energy Star Shipping Report
	Television	Bottom-Up	Top-Down	Energy Star Shipping Report

To ascertain information for the bottom-up approach about the energy efficient measures the Companies' residential customers purchased during 2018, ADM conducted an online survey through SurveyGizmo. The survey asked a plethora of questions about the customer's energy efficient equipment purchases and resulted in a rich data set of information from a statistically significant group of 3,709 customers. Statistical tests were further conducted to ensure there was no statistically significant difference between the survey sample and the Companies' service territories with respect to demographic characteristics that may influence energy efficient measure purchasing behavior. The percent of purchases and installations for each measure type in the survey was used to extrapolate to the Companies residential household population for each operating company. The extrapolation procedure took into account whether the measures were Energy Star rated, actually installed through field verification visits, and removed any potential cross-participation with the companies' other EE Programs.

The top-down approach used a combination of recent market data from U.S. Energy Information Administration (EIA) along with energy efficient equipment shipping and sales data from the Association of Home Appliance Manufacturers (AHAM), Air Conditioning Heating and Refrigeration Institute (AHRI), and Energy Star. Counts of the Companies' residential customers by zip code was combined with income information to estimate the number of energy efficient equipment purchased and installed within the Companies' service territories during 2018. These results were checked against the most recent sales and shipping data to corroborate the top-down results. For the 2018 CAP Program, both approaches were integrated to achieve and corroborate the ex-post savings.

- The bottom-up approach was used to estimate ex-post energy savings and demand reduction for all lighting, refrigeration and consumer electronics measures with a secondary approach used to corroborate savings as described below.
 - For CFLs, LEDs, and halogen bulbs, the top-down approach employed a lighting consumption model as an independent check on the ex-post savings.
 - For refrigeration and freezers, the top-down approach used EIA data on purchasing behavior by income and AHAM shipping data as an independent check on ex-post savings.
 - In 2018 consumer electronics made up a significant part of the survey respondents' energy efficient purchases and were added into the measure mix. A top-down approach using Energy Star shipping information was combined with US census information and EIA data to estimate the number of energy efficient consumer electronics shipped to the Companies' territory in 2018 was used to corroborate the bottom-up results.
- Because of the low incidence of survey respondents with HVAC purchases in the bottom-up approach, ex-post savings were calculated using the primary EIA and AHRI data based top-down approach, with the exception of dehumidifiers whose ex-post was calculated with the bottom-up approach.
 - The bottom-up results for HVAC measures central A/C, room A/C, and Heat Pumps were used as an independent check on the top-down calculated ex-post savings.
 - In 2018, Dehumidifiers were added to the measures assessed under HVAC and ex-post savings were calculated using the bottom-up approach and corroborated using the EIA and AHAM data based top-down approach.

The energy savings calculations were conducted using Ohio TRM Deemed Savings and engineering algorithms. Savings from measures rebated through the Companies' 2018 program offerings were removed from the CAP savings estimates. A summary of the measure-level energy savings results is shown in Table 1-2.

Table 1-2: Residential Energy Savings

Operating Companies	Measure	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)	Lifetime Savings (kWh)
CEI	HVAC	8,497,562	5,522.77	128,534,413
OE	HVAC	11,863,169	7,710.16	179,442,706
TE	HVAC	3,508,825	2,280.47	53,074,603
Total		23,869,556	15,513.40	361,051,722
CEI	Refrigeration	12,529,292	2,129.17	192,381,541
OE	Refrigeration	17,491,737	2,972.46	268,577,601
TE	Refrigeration	5,173,612	879.18	79,438,445
Total		35,194,641	5,980.81	540,397,587
CEI	Lighting	16,500,877	2,521.62	220,830,668
OE	Lighting	22,917,884	3,502.25	306,709,261
TE	Lighting	6,417,008	980.63	85,878,593
Total		45,835,769	7,004.50	613,418,522
CEI	Consumer Electronics	12,636,145	1,047.63	62,583,991
OE	Consumer Electronics	17,640,910	1,462.56	87,371,470
TE	Consumer Electronics	5,217,734	432.59	25,842,266
Total		35,494,789	2,942.78	175,797,727
Residential Total		140,394,755	31,441.49	1,690,665,558

1.2 Commercial & Industrial

The commercial and industrial (C&I) component of the CAP was evaluated by selecting a random sample of the Companies' C&I customers to evaluate energy savings associated with program-associated measures. The population of customers for which the sample was taken, excluded opt-out customers², and customers who participated in the 2018 Mercantile, Large Commercial, and Small Commercial Programs. The sample was generated by stratifying the population of businesses within the Companies' service territories based on average annual energy usage (kWh). For program year 2018, a total

² Beginning January 1, 2017, a customer (as defined in R.C. § 4928.6610) of an electric distribution utility may opt out of the opportunity and ability to obtain direct benefits from the utility's portfolio plan as described in R.C. § 4928.6611.

of 173,768 general service business customers comprised the population of entities that may have implemented CAP-associated energy efficiency measures.

Customers were surveyed by phone to collect information pertaining to CAP-associated energy efficiency measures. After a brief introduction, survey respondents were requested to indicate whether they installed any energy efficient equipment during 2018. Respondents who indicated installing equipment during 2018 were then asked detailed questions regarding the installed equipment. ADM completed decision maker surveys for 2,501³ out of 27,461 chosen program-eligible entities. Of those respondents, 383 claimed to have installed energy efficient equipment during 2018. ADM performed a site visit to verify measure implementation for 147 of these respondents, of which 110 sites provided all the required documentation to verify installation. Out of those 110 sites, 87 of them implemented energy efficient equipment resulting in energy savings.

For each business location indicating implementation of energy efficiency equipment, ADM completed a process including decision maker interview (survey), documentation collection, and a site visit to obtain data to enable ADM to calculate energy savings, summer coincident peak savings, and lifetime energy savings.

Energy efficient equipment installed during 2018 reported by the sampled survey respondents was associated with 962,366 kWh of annual energy savings. The summer coincident peak savings for this sample of businesses was 185.23 kW. A summary of the sample-level energy savings results is shown in Table 1-3.

Table 1-3: C&I Sample Energy Savings

Operating Company	Energy Savings (kWh)	Summer Coincidence Peak Savings (kW)
CEI	421,061	81.20
OE	419,971	79.04
TE	121,334	25.00
2018 Total	962,366	185.23

Energy savings measures considered for CAP include lighting, HVAC, refrigeration, appliances, motors, and other equipment. The energy savings calculated for each business was a summation of all the energy efficiency measures observed within the businesses premise.

³ One site did not complete a decision maker survey but did participate in a site visit. This site was included in the sample savings and counts.

Savings from the sample were extrapolated to the population based on the sample stratification and are presented by rate class for each operating company. No savings from customers participating in the Companies programs were extrapolated to other customers, nor were savings extrapolated to customers that participated in the Companies' programs or customers that are on the list to opt-out. The extrapolated annual energy savings for all operating companies are 42,579,059 kWh. The extrapolated summer coincident peak savings for all operating companies was 8,699.78 kW. A summary of the savings by rate class is shown in Table 1-4.

Table 1-4: C&I Extrapolated Energy Savings

Strata	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)	Lifetime Savings (kWh)
CEI-GS	19,553,981	4,427.56	241,715,544
OE-GS	16,644,777	2,900.05	158,083,963
TE-GS	6,380,301	1,372.17	80,958,478
C&I Total	42,579,059	8,699.78	480,757,985

2 Introduction and Purpose of Study

The purpose of this report is to present the results of the impact evaluation effort undertaken by ADM to quantify the energy savings and peak demand reductions that were achieved through actions taken by customers outside of the utility-administered programs. This was accomplished by employing a variety of approaches to capture customer and market information; including surveying efforts, market research, analyzing reports from industry groups, and site verification visits.

2.1 Residential

The residential section of this report presents the results of the impact evaluation of the CAP residential customer during 2018. The overall objective of the impact evaluation of the CAP residential program was to verify the gross energy savings (kWh) and peak demand (kW) reduction resulting from energy efficiency measures installed during 2018 by residential customers within the Companies' service territories, that are not counted in other utility-administered efficiency programs.

The approach for the impact evaluation had the following main features.

- A survey effort of customers to determine energy efficiency measures installed during the calendar year 2018.
- On-site data collection was conducted for a subsample of survey respondents to gather verification information facilitating determination of CAP energy savings and peak demand reductions.
- Residential energy savings for the energy efficiency measures were estimated using the Ohio TRM.

The research questions for the evaluation of the residential component of CAP include the following:

- Are the Companies' residential customers purchasing energy efficient equipment outside of utility-administered efficiency programs?
- What information will residential customers provide regarding energy efficient equipment installed during 2018?

2.1.1 Residential Market Data Acquisition

The sample frame for measurement and verification of residential CAP energy savings includes all 1,864,635 of the Companies' residential customers in single and multifamily dwellings. During the initial stages of the measurement and verification effort, the Companies provided a list detailing the number of residential customers in their service territories by zip code.

ADM then did a random sampling based on the Companies' 2018 billing data for each customer. ADM randomly selected customers from each zip code of each of the service territories taking into consideration their monthly kWh consumption. In order to ensure that the number of responses are large enough and adequately represent the demographics of the Companies territories, ADM randomly selected 50,000 customers for the online survey. This sample was further split into three waves of surveys; with the first and second waves comprising of 20,000 participants each and the third wave made up of 10,000 participants. Customers in the sample were invited to participate in an online survey through SurveyGizmo and asked banks of questions about their lighting, HVAC, appliance, and consumer electronics purchases made during 2018. The survey gathered information on the number of the energy efficient equipment purchased by the Companies' customer, the specific stores from which these purchases were made, installation and usage patterns of the participants. Additionally, the survey asked questions regarding demographics and the structure of the household.

The sample size of the survey effort facilitated estimation of residential CAP energy savings at +/-10% statistical precision at a 95% confidence level. The target sample size was further augmented to account for a certain number of respondent refusals of on-site visits. In 2018, there were 3,709 completes after the third wave of the survey. A survey was considered to be complete if a respondent agrees to participate in the survey, answers whether energy efficient equipment has been installed and accept or deny ADM access to perform a site verification visit. For cases in which equipment was installed, detailed information about the equipment was acquired. Evaluated energy efficiency equipment included the following categories:

- Lighting
- HVAC
- Refrigeration
- Consumer Electronics

Following survey completion, ADM attempted to contact all the survey respondents who purchased the equipment and indicated their willingness to participate in a site verification visit. Subsequently, site visits were scheduled to gather the information on the claimed efficiency measures. During site visits, ADM staff conducted a detailed energy audit of the various equipment respondents claimed to have purchased in 2018. This included but was not limited to identifying and counting all existing energy efficiency measures such as lighting, refrigeration, HVAC and consumer electronics.

A summary of statistics for residential market data acquisition is shown in Table 2-1.

Table 2-1: Residential Market Data Collection Effort Statistics

Unit	Quantity
Population Size (Residential Households)	1,864,635
Customers Completing Survey	3,709
Residential Site Visits	184

2.2 Commercial & Industrial

The overall objective for the impact evaluation of the CAP C&I Program was to verify the gross energy savings (kWh) and peak demand (kW) reduction resulting from energy efficiency measures installed during 2018 by businesses within the Companies' service territories, that are not counted in other utility-administered efficiency programs.

The approach for the impact evaluation included the following main activities and approaches:

- Customers were recruited for the study to identify energy efficiency measures installed during the calendar year 2018.
- Available documentation from the participants was reviewed, with attention given to proof of purchase, verification of equipment installation, and verification of the quantity of equipment installed.
- On-site data collection visits were conducted to gather information to facilitate calculation of CAP energy savings and peak demand impacts.
- Per Ohio RC §4928.662, for all measure types listed in the Ohio TRM; all installation rates, deemed savings, and hours of use were calculated per the Ohio TRM ("Deemed"). In addition, ADM calculated gross savings for measures in the program with "as found" baseline conditions, hours of use, and installation rates. The values reported for ex-post energy savings (kWh) and peak demand reduction (kW) represent the higher calculated value obtained from both methodologies.
- Program energy savings were estimated using the Ohio TRM:
 - Analysis of lighting savings was accomplished using ADM's custom-designed lighting evaluation tool with system parameters (fixture wattage, operating characteristics, etc.) based on information on operating parameters collected on-site, from the Ohio TRM, and, if appropriate, industry standards.
 - Analysis of non-lighting measures was accomplished using ADM's custom-designed non-lighting evaluation tool based on information on

operating parameters collected on-site, from the Ohio TRM, and, if appropriate, industry standards.

The research questions for the CAP C&I include:

- Are the Companies' C&I customers purchasing energy efficient equipment outside of efficiency programs?
- Will C&I customers willingly provide information on energy efficient equipment installed in 2018?

2.2.1 Participant Commercial and Industrial Market Data Acquisition

ADM developed a sample of the Companies' C&I customers to facilitate measurement and verification of CAP energy savings achieved by the population of C&I customers. The size of the sample was to meet a +/-10% statistical precision at a 95% confidence level for each EDC. The Companies provided ADM with customer-level data on the energy use of their C&I customers. The data included customer contact information that assisted ADM's survey administration efforts. To generate an appropriate population (for extrapolation of the sample) of C&I customers, the database was filtered to remove the following customers:

- Customers without 12 prior months of meter data (07/2016 - 07/2018)
- Customers with non-current or expected non-current accounts (including inactive accounts in the months of June and July 2018)
- Customers with any months of zero or negative savings within the chosen 12-month period⁴
- Customers with less than 2,000 annual kWh usage
- Opt-out customers of the Companies' energy efficiency programs
- Meter locations classified as STL, TRF, GSU, GP, GT, and POLS
- Customers who participated in other utility administered efficiency programs

The remaining population of C&I customers (173,768) were grouped into strata, by EDC, based on the customer level of annual energy usage. The size of the sample was dependent on the survey response rate, so a survey population was generated randomly based on a conservatively anticipated survey response rate of 5% to meet precision

⁴ The provided database of commercial and industrial businesses contained negative meter data for some businesses.

goals. The target sample size was augmented to account for a certain number of respondent refusals of on-site visits. Therefore, to achieve the desired number of survey respondents, many businesses were randomly chosen for the survey population. The total number of businesses chosen from the population in which sampling was performed was 27,461. ADM contacted customers by referencing phone contact information contained in data provided to ADM by the Companies. A total of 2,501⁵ sites who were contacted completed decision maker surveys. This is considered to be the size of the sample for 2018.

The survey population was presented a survey to determine:

- Energy efficiency equipment installed in 2018
- Which energy efficiency equipment was installed in 2018

To obtain businesses to participate in the survey, they were called over the course of 8 weeks towards the end of 2018. Callbacks were made at different times of the day, and different days of the week. A survey was complete if the respondent agreed to the survey and answered whether energy efficient equipment was installed or planned to be installed in 2018. However, surveys were considered to have a response if they reached the decision point of informing whether they installed energy efficiency equipment. After this point, detailed information about the equipment was acquired. Energy efficiency equipment was broken down into the following categories:

- Lighting
- HVAC
- Refrigeration
- Appliances
- Motors
- Other

These categories of topic areas were chosen based on information provided in the Ohio TRM and Department of Energy's list of Standards and Procedures for calculating energy savings. A category listed as "other" was included to cover any warranted energy savings measures that may have been installed.

Upon completion of the survey, each respondent willing to participate was contacted by an ADM Associate through a follow-up phone call. The intent of the phone call was to

⁵ One site did not complete a decision maker survey but did participate in a site visit. This site was included in the sample savings and counts.

gather documentation and information not acquired during the survey. Documentation included:

- Letter of Attestation for equipment installed in 2018
- Proof of purchase: invoices, receipts, etc.
- A signed W-9

Additionally, a copy of a utility bill was collected from each site as optional documentation and was only collected if the site was willing to provide one.

Upon further communication with each respondent, a site visit was scheduled, for those willing to continue their participation, to gather the necessary information to calculate accurate energy savings. Site visits included the verification of each energy efficiency measure installed within the business. If a survey respondent completed the survey but did not wish to participate further, they were still considered to be part of the sample, but without verified energy savings. Of the businesses who claimed measures in 2018, 147 were visited by ADM field technicians. ADM visited every business accepting a site visit.

Of the site verification visits, 87 demonstrated verifiable savings with proper documentation. A summary of statistics for participant acquisition is shown in Table 2-2.

Table 2-2: Participation Statistic

Sample	Customers
General Service Business Customer Population	173,768
Survey Population	27,461
Survey Respondents (Sample)	2,501 ⁶
Sample Businesses with Reported Installed Measures in 2018	383
Sample Site Visits	147
Sample Sites with Verified Energy Savings	87

⁶ One site did not complete a decision maker survey but did participate in a site visit. This site was included in the sample savings and counts.

3 CAP Residential

3.1 Program Description

The primary objective of CAP is to determine the energy savings from the Companies' customers without participating in a utility-administered efficiency program. CAP is a Market Research Study in which participants are chosen randomly such that energy savings findings can be extrapolated to the population within the Companies' service territories.

The residential CAP quantifies energy savings for the population of the Companies' residential customers occurring from actions taken outside of a program design. The energy efficiency measures considered for residential CAP in 2018 include lighting, HVAC, refrigeration and consumer electronics. Primary data associated with the Companies' customers' energy efficiency actions and purchasing behaviors was collected via an online survey as described in Section 2.1, as well as through site visits and available sources of energy efficiency equipment sales and shipping data.

3.1.1 Dual Participation Considerations

To ensure savings verified in the CAP were not originally generated through any other program in the Companies' portfolio offerings, ADM crosschecked participation with the 2018 Residential EE Programs. If a CAP survey respondent was included as a participant in another program offering, their calculated savings were not included in CAP or extrapolated to the CAP population. Additionally, the total number of specific measures installed or incentivized by the 2018 Residential EE Programs were also subtracted from the overall estimate of CAP measures. While this method could potentially remove more than the EE Program measures, it is a conservative approach that ensures the Companies are not double counting savings between CAP and other EE Programs.

3.2 Methodology

This chapter provides a description of the methodology applied by ADM in the evaluation of the CAP during 2018.

ADM employed varying evaluation strategies in performing an impact evaluation of the residential measures of the program. For each measure, ADM employed two strategies to calculate ex-post savings:

- A bottom-up approach utilizing primary data collected from the Companies' service territories via an online survey (SurveyGizmo) and verified through field visits.
- A top-down approach utilizing macro-level data.

The evaluation strategies for each measure are discussed in more detail in the following sections.

3.2.1 Sampling Design and Extrapolation Methods

In order to ascertain information about the energy efficient measures purchased by the Companies' residential customers during 2018, ADM conducted an online survey through SurveyGizmo. The survey asked an in-depth array of questions about the customer's energy efficient equipment purchases which resulted in a rich data set of information from 3,709 customers.

The data collected from the survey respondents was used to determine the percent of residential customers who purchased each of the measures in the program. In addition to quantifying purchasers in the service territory, the data collected was also used as inputs to the Ohio TRM savings algorithms.

For the impact analyses of the residential measures in the program, data from the survey was extrapolated to the entire population of the Companies' residential households. ADM ensured the statistical representation of the online survey sample through several steps.

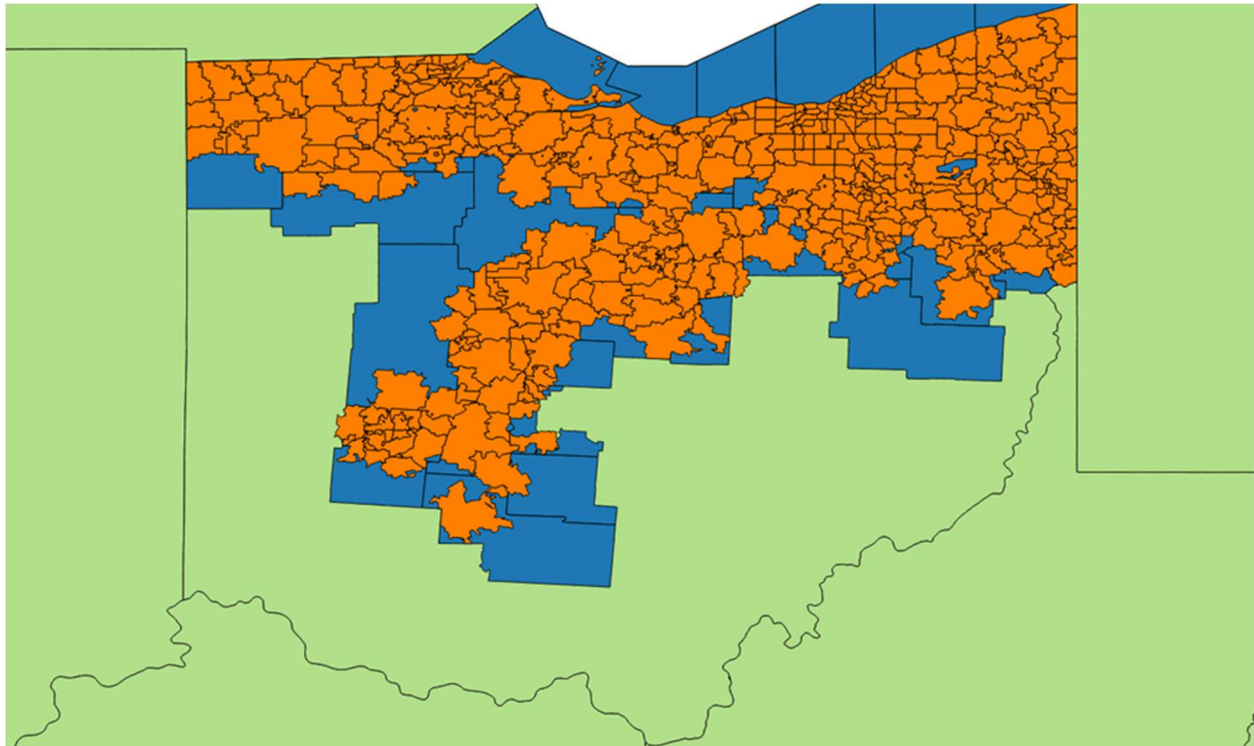
ADM randomly selected customers from the Companies' 2018 billing data in the OH zip codes within the Companies' service territories, by stratifying the random sample on their monthly kilowatt hour consumption. A total of 50,000 residential customers were randomly selected for the study. Additionally, ADM cross-checked the entire sample to ensure they had not been a participant in another EE Program offering.

A subset of the online survey sample was provided the opportunity to participate in an incentivized on-site verification visit. The data collected during the site visits were used to further verify self-report data collected through the online survey. In addition, this information was used in determining the verification rates for measures whose ex-post savings was calculated through the bottom-up method.

A statistical comparison was then made to ensure there wasn't a statistically significant difference between the online survey sample and the Companies' service territories with respect to demographic characteristics that may influence energy efficient purchasing behavior. The comparison used the 3,709 survey responses collected for the Companies with gold-standard Census Bureau data for Ohio. The most recently updated data was used and was the 2015 five-year household level Public Use Microdata Set (PUMS) of the American Community Survey (ACS). This dataset was chosen because it assured coverage of all census blocks over a 5-year period and has the most granular geography available from the Census Bureau. Other datasets, such as the one and three-year ACS and American Household Survey (AHS), lack coverage and the geographic identifiers below state level to conduct this analysis. Two geographies were covered, the state of Ohio, and all the Public Use Microdata Areas (PUMAs) that contained the Companies'

service territories. Each is a Census Bureau geographic area constructed of census blocks and contains at least 100,000 residents. Figure 3-1 illustrates how well the PUMAs (orange) were contained within the Companies' service territories (blue).

Figure 3-1: Census Tabulation Areas Containing the Companies' Service Territories Compared to PUMAs Containing the Companies' Service Territories



The first technique used was multiple imputation, to replace missing data. The R function *aregImpute* from the package “Hmisc” was used because of its robust algorithm. After missing data was replaced, target values were generated from ACS data for PUMAs that covered the Companies' service territories, using customer counts from the Companies. A comparison of the population targets, original sample, and weighted sample is shown in Table 3-1 below.

Table 3-1: Population, Sample, and Weighted Sample Counts and Percentages for the Demographics Used to Compare the Survey Respondents to the FE Customer Population

Length of Residence	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
Less than 2 years	18.30%	421	11.35	679	18.30%	6.95%
2 to 4 years	16.80%	687	18.52	623	16.80%	-1.72%
5 to 9 years	17.50%	559	15.07	649	17.50%	2.43%
10 to 19 years	21.60%	718	19.36	801	21.60%	2.24%
20 to 29 years	11.20%	386	10.41	415	11.20%	0.79%
30 years or more	14.60%	393	10.60	542	14.60%	4.00
Building Type	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
Other	3.30%	144	3.88%	122	3.30%	-0.58%
Single Family	74.70%	3,196	86.17%	2,771	74.70%	-11.47%
Multi-Family	22.00%	369	9.95%	816	22.00%	12.05%
Heating Fuel	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
Gas/LP	77.00%	2,806	75.65%	2,856	77.00%	1.35%
Electricity	17.50%	544	14.67%	649	17.50%	2.83%
Other	5.50%	359	9.68%	204	5.50%	-4.18%
EDC	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
CEI	35.60%	1,369	36.91%	1,320	35.60%	-1.31%
OE	49.70%	1,810	48.80%	1,843	49.70%	0.90%
TE	14.70%	530	14.29%	545	14.70%	0.41%
Home Ownership	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
Owned Outright	35.60%	875	23.59%	1,320	35.60%	12.01%
Owned with mortgage or loan	49.70%	2,064	55.65%	1,843	49.70%	-5.95%
Rent or other	14.70%	770	20.76%	545	14.70%	-6.06%
Home Age	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
1949 or earlier	29.10%	868	23.40%	1,079	29.10%	5.70%
1950-1969	27.40%	920	24.80%	1,016	27.40%	2.60%
1970-1989	21.70%	716	19.30%	805	21.70%	2.40%
1990 or later	21.80%	828	22.32%	809	21.80%	-0.52%
Number of Rooms	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
1 to 4	21.80%	377	10.16%	809	21.80%	11.64%
5 to 6	39.70%	1,165	31.41%	1,472	39.70%	8.29%
7 to 8	25.80%	1,190	32.08%	957	25.80%	-6.28%
9+	12.70%	977	26.34%	471	12.70%	-13.64%

Number of Bedrooms	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
1	10.10%	143	3.86%	375	10.10%	6.24%
2	25.60%	700	18.87%	950	25.60%	6.73%
3	43.50%	1756	47.34%	1,613	43.50%	-3.84%
4+	20.80%	1,110	29.93%	771	20.80%	-9.13%
Number of Occupants	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
1	30.00%	685	18.47%	1,113	30.00%	11.53%
2	35.00%	1,488	40.12%	1,298	35.00%	-5.12%
3	15.00%	608	16.39%	556	15.00%	-1.39%
4	11.80%	557	15.02%	438	11.80%	-3.22%
5+	8.20%	371	10.00%	304	8.20%	-1.80%

Table 3-2 compares the frequency distributions of the residence types in the Companies' service territories to the sample of the online survey respondents. The distributions are not statistically different and are dominated by single-family homes.

Table 3-2: Comparison of Online Survey Sample and the Companies' Service Territories Building Type Frequency Distributions

Building Type	Service Territory	Online Survey
Single-Family	83%	86%
Mobile Home	3%	2%
Apartment	13%	10%
Condominium	1%	0%
Other	0%	2%

3.2.2 Residential Impact Analysis Methods

There were four residential measure categories investigated in the evaluation of the CAP: Lighting, Refrigeration, HVAC and Consumer Electronics. The sections below detail the impact analysis methodologies for each of these measure categories.

3.2.2.1 Lighting

ADM calculated the energy savings and demand reductions produced by the Companies' customers installing energy efficient lighting during 2018. ADM investigated the following bulb types: halogens, CFLs, and LEDs. In order to ensure that respondents were self-reporting the bulbs count correctly, the data was filtered to include only light bulbs purchased in 2018. Then for each bulb type a respondent claimed to have purchased, the respondent was asked qualifying questions about identifying the bulb type and if they are familiar with currently available bulb technologies. Finally, the stated quantity of bulbs the respondent said they purchased was checked across multiple question blocks to confirm

that it was consistent throughout the survey. If a survey respondent did not meet these criteria, they were filtered out of the program participant counts.

ADM employed two evaluation strategies in performing an impact evaluation of the lighting program. The two strategies were:

- A bottom-up approach utilizing primary data collected from the Companies' service territories via online survey (SurveyGizmo) and verified through field visits. This method was used to calculate the ex-post savings.
- A top-down approach utilizing a FE territory wide lighting consumption model. This method was used to corroborate the ex-post results from the bottom-up approach.

Bottom-Up Approach

Using the bottom-up strategy, ADM estimated energy savings and demand reduction for each lighting measure using the OH TRM algorithms with data obtained from the online survey and augmented as necessary from site visits and ancillary studies.

ADM quantified the total energy savings (*kWhSavingsLighting*) and demand reduction (*kWSavingsLighting*) associated with the Companies' customers installing energy efficient lighting during 2018 by first calculating the total annual savings for each bulb type *t* (Equation 3-1), and then summing all of the annual savings values calculated using Equation 3-1 (Equation 3-2).

$$kWhSavings_t = kWhSavings_{Bulb_t} * n_{Bulb_t/Household} * n_{FE Households}$$

Equation 3-1

$$kWhSavingsLighting = \sum kWhSavings_t$$

Equation 3-2

Where:

- | | |
|---|--|
| <i>t</i> | = the type of light bulbs
= Halogens, CFLS, and LEDs |
| <i>kWh Savings_{Bulb_t}</i> | = the average annual savings per bulb for each bulb type <i>t</i> |
| <i>n_{Bulb_t/Household}</i> | = the average number of bulbs replaced in each household for each bulb type <i>t</i> |

$n_{FE\ Households}$ = the number of households in the Companies' service territories⁷

The average annual savings per bulb for each bulb type was calculated using the following OH TRM algorithms for energy and demand.

$$kWh\ Savings_{Bulb_t} = ((\Delta Watts_{Bulb_t})/1000) * HOU_{Bulb_t} * WFHe * ISR$$

Equation 3-3

Where:

$\Delta Watts_{Bulb_t}$ = The difference between the average wattage for bulb type t and the average wattage of the type of bulb type t replaced (the "As Found" wattage)⁸

HOU_{Bulb_t} = Average annual hours of use for bulb type t

$WFHe$ = Waste Heat Factor for energy⁹

ISR = In Service Rate¹⁰

To remove the LED bulbs that could have potentially come from the 2018 EE Products upstream lighting program, when $t = LEDs$, the input in $n_{FE\ Households}$ is equal to Equation 3-4.

$$n_{FE\ Households} = n_{All\ FE\ Household} - P_{Lighting\ Program\ Households}$$

Equation 3-4

Where:

$n_{All\ FE\ Household}$ = Total number of households in the FE territory

⁷ This value is 1,864,635.

⁸ The "As Found" wattage is a blended value determined from survey questions that captured the various bulb types customers replaced with their newly purchased energy efficient bulbs.

⁹ Parameter to account for effects on heating/cooling from efficient lighting. This value is 1.07 and from the OH TRM.

¹⁰ This value is 1. The installation rates associated with the bulbs purchased by the Companies' customers was accounted for in the equation that calculates the average number of bulbs replaced in each household.

$P_{Lighting\ Program\ Households}$ = The estimated number of households participating in the 2018 EE Products upstream program. This is calculated by dividing the total number of program LED bulbs incentivized (2,160,774) by the average number of bulbs purchased by households in 2018 (5.83 LEDs, from the survey)

$$kW\ Savings_{Bulb_t} = ((\Delta Watts_{Bulb_t})/1000) * WFHd * CF * ISR$$

Equation 3-5

$$kWSavings_{Lighting} = \sum kWSavings_t$$

Equation 3-6

Where:

$\Delta Watts_{Bulb_t}$ = The difference between the average wattage for bulb type t and the average wattage of the type of bulb type t replaced (the “As Found” wattage)¹¹

CF = Summer Peak Coincidence Factor¹²

$WFHd$ = Waste Heat Factor for demand¹³

ISR = In Service Rate

$$n_{Bulb_t/Household} = \sum Survey_{Bulb_t} / \sum Survey_{Participants}$$

Equation 3-7

Where:

$\sum Survey_{Bulb_t}$ = The sum of all bulbs t verified to have been installed by telephone survey participants¹⁴

$\sum Survey_{Participants}$ = The sum of all customers who participated in the online survey¹⁵

¹¹ The “As Found” wattage is a blended value determined from survey questions that captured the various bulb types customers replaced with their newly purchased energy efficient bulbs.

¹² Parameter for accounting for how much of the energy savings coincides with summer peak demand hours. This value is 0.11 and from the OH TRM.

¹³ Parameter to account for cooling savings from efficient lighting. This value is 1.21 and from the OH TRM.

¹⁴ This value was derived from a question that asked survey participants how many of each bulb type they purchased during 2018. The value was filtered by several factors including: 1) A verification/installation rate based on site visits 2) consistency check questions in the survey 3) the participant’s familiarity with light bulb technologies.

¹⁵ There were 3,709 of the Companies’ customers who completed the online survey.

Top-Down Approach

The following top-down approach employs a lighting consumption model as an independent check on the ex-post savings calculated via the bottom-up approach described above. Total 2018 calendar year kWh savings from energy efficient lighting by the Companies' residential households is represented by $kWhSavingsLighting^{2018}$.

To calculate $kWhSavingsLighting^{2018}$, ADM examined the difference between the Companies' residential households' total calendar year 2018 lighting consumption (kWh) (the baseline year) and the Companies' residential households' total calendar year 2018 lighting consumption (kWh). This is illustrated in Equation 3-8 below:

$$kWhSavingsLighting^{2018} = ConsumptionLighting^{2017} - ConsumptionLighting^{2018}$$

Equation 3-8

Lighting consumption for bulb type t (incandescent, halogen, CFL and LED) in year y is a function of the bulb counts (units) for each bulb type t (Incandescent, Halogen, CFL and LED) at the end of each year y (December 31st) multiplied by the average annual consumption (kWh) for each bulb type t . This is illustrated in Equation 3-9 below.

$$ConsumptionLighting_t^y = n_{Bulb_t}^y * AverageConsumption_{Bulb_t}$$

Equation 3-9

To remove the EE Products incentivized LED bulb savings from the top-down CAP LED savings already attributed to the EE Products program, Equation 3-10 is used to subtract the lighting program savings. The number of incentivized program bulbs is multiplied by the installation rate identified through the survey and the average LED savings, then subtracted from the kWh savings $kWhSavingsLighting_{Modeled\ Savings}^{2018}$.

$$kWhSavingsLighting_{Final\ Savings}^{2018} = kWhSavingsLighting_{Modeled\ Savings}^{2018} - (nIncentivized\ Program\ Bulbs * Installation\ Rate * average\ LED\ savings)$$

Equation 3-10

The summation of the annual lighting consumption across all three bulb types t is equal to the total lighting consumption in year y .

$$ConsumptionLighting^y = \sum ConsumptionLighting_t^y$$

Equation 3-11

The bulb counts at 12/31/2018 in the Companies' residential households is derived by multiplying the percent of sockets occupied by bulb type t ¹⁶ by the average number of sockets per household¹⁷ by the total number of households.¹⁸ This is illustrated in Equation 3-12 below:

$$n_{Bulb_t}^y = \%SocketsOccupied_{Bulb_t} * nSockets_{Bulb_t} * n_{FE House}$$

Equation 3-12

The average annual consumption for each bulb type b calculated by multiplying the expected annual hours of use for each bulb type b by the average load (W) per bulb type t ¹⁹ and dividing by 1,000. This is illustrated in Equation 3-13 below:

$$AverageConsumption_{Bulb_t} = (ExpectedAnnualHOU_{Bulb_t} * AverageLoad_{Bulb_t})/1000$$

Equation 3-13

The expected annual hours of use for each bulb type t is calculated by multiplying the expected daily hours of use²⁰ by 365. This is illustrated in Equation 3-14 below.

$$ExpectedAnnualHOU_{Bulb_t} = ExpectedDailyHOU_{Bulb_t} * 365$$

Equation 3-14

The bulb count at 12/31/2018 in the Companies' residential households begins with the bulb type t count at 12/31/2017 in the Companies' residential households calculated in Equation 3-12 and then subtracts the number of bulb type t that burnout during 2018 and then adds back the number of bulb type t that would be replaced in 2018. This is illustrated in Equation 3-15 below:

$$n_{Bulb_t}^{2018} = n_{Bulb_t}^{2017} - nBurn_{Bulb_t}^{2018} + nReplace_{Bulb_t}^{2018}$$

Equation 3-15

The count of bulb type t that will burn out in 2018 is calculated by multiplying the bulb count at 12/31/2018 by the rate at which bulb type t burns out (Equation 3-16).

¹⁶ http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf

¹⁷ http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf

¹⁸ This value is 1,864,635.

¹⁹ <http://www.eia.gov/todayinenergy/detail.cfm?id=415>

²⁰ http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf

$$nBurn_{2018} = n_{Bulb_t}^{2017} * BurnRate_t$$

Equation 3-16

Each bulb type's burn rate is calculated by dividing unity by bulb type t 's measure life (years).²¹

$$BurnRate_t = 1/MeasureLife_t$$

Equation 3-17

The number of type t bulbs that replace each of the burned-out bulbs²² was calculated by multiplying the count of bulb type t that will burn out in 2018 by the rate at which each bulb type t is likely to replace a burned-out bulb.²³

$$nReplace_{Bulb_t}^{2018} = nBurn_{2018} * ReplaceRate_{Bulb_t}$$

Equation 3-18

3.2.2.2 HVAC

ADM calculated energy savings and demand reductions produced by the Companies' residential customers purchasing energy efficient HVAC equipment during 2018. ADM investigated the following HVAC measures: Room Air Conditioners (RAC), Central Air Conditioners (CAC) and Heat Pumps. In 2018, Dehumidifiers were included among the measures assessed under HVAC. ADM performed an analysis with data provided by the Companies, the United States Census Bureau, the EIA data, the AHRI data, and the AHAM data.

ADM developed two analysis approaches to calculate the quantity of residences who purchased Room Air Conditioners (RAC), Central Air Conditioners (CAC), Heat Pumps and Dehumidifiers in 2018.

- A top-down approach utilizing market research data from the EIA and shipping and sales data from the AHRI and AHAM sources. The quantities estimated from this method, minus the quantity of measures that were incentivized in the 2018 EE Products program, were used to calculate the quantity of Room Air Conditioners (RAC), Central Air Conditioners (CAC), Heat Pumps used in the ex-

²¹ Each bulb types average life in years was calculated by dividing each bulb's typical rated life (hours) (http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/lifetime_white_leds.pdf) by $ExpectedAnnualHOU_{Bulb_t}$

²² The Lighting Consumption model assumes that all bulbs which burned out in 2018 were replaced. This was probably not the case and the reason why the savings estimated using the top-down approach is larger than the bottom-up approach.

²³ The bulb t replacement rates were derived from questions 41-58 in the online survey and question 16 in the April 2015 FE OH Market Potential survey.

post savings calculation. Dehumidifier's ex-post savings calculated from the bottom-up method were corroborated with the EIA and AHAM based analyses.

- A bottom-up approach utilizing primary data collected from the Companies' service territories via online survey and verified during field surveys. This method was used to calculate the ex-post savings for Dehumidifiers and corroborate the quantity for the rest of the HVAC measures, minus the quantity incentivized in the 2018 EE Products program.

Top-Down Approach

The total annual energy (kWh) savings for each HVAC type t was calculated using Equation 3-19 below.

$$kWhSavings_{HVAC_t} = kWhSavings_{HVAC_t} * n_{HVAC_t}$$

Equation 3-19

Where:

- t = the types of HVAC units
= CAC, RAC, Heat Pumps and Dehumidifiers
- $kWhSavings_{HVAC_t}$ = Annual kWh savings per HVAC unit type t
- n_{HVAC_t} = Number of type t HVAC units purchased in 2018 minus the number of incentivized units in the EE products program

Summing across the annual savings for all HVAC types t provides the total savings for the residential HVAC measure.

$$kWhSavings_{HVAC} = \sum kWhSavings_{HVAC_t}$$

Equation 3-20

The number of type t HVAC units (n_t) purchased in 2018, was calculated by first obtaining the percentage of residences in Ohio in each zip code per income bracket. Next, the percentage of residential households in each zip code per income bracket that purchased a unit in 2018 was determined using the EIA market data²⁴, as well as the number of the Companies' residential households in each zip code per income bracket. Finally, the above inputs were used in conjunction with the Climate Factor to calculate the number of

²⁴ This data is from a 2013 survey that presents the number of energy efficient measures purchased by income bracket. The total sales or shipped units of each measure in 2018 to the FE territories is used to update the 2013 survey counts for 2018.

HVAC units (not including Dehumidifiers) of type t in the Companies' service territories during 2018.

These steps are summarized in Equation 3-21 below:

$$n_{HVAC_t} = \sum_z \sum_i P_{zi} * R_i * CF_z * V$$

Equation 3-21

Where:

z	= Zip Codes in the Companies' service territories ²⁵
i	= Income Bracket Levels ²⁶
	= Annual Income per Residence
	= [0,20,000) u [20,000,40,000) u [40,000,60,000) u [60,000,100,000) u [100,000,∞)
P_{zi}	= Number of residential households in Zip Code z , with Income Bracket i
R_i	= Percentage of residential households, with income bracket i , with a unit purchased in 2018 ²⁷
CF_z	= Climate Factor for Zip Code z
	= Region rate which effects usage and sales of units ²⁸
V	= Verification Rate
	= $\frac{\text{Number of Sites Visited with Verified Measure Installed}}{\text{Number of Sites Visited Claiming to have Measure Installed}}$
	= 56% for Room AC; 50% for Central AC; NA for Heat Pump

Where:

$$\frac{\text{Number of Sites Visited with Verified Measure Installed}^{29}}{\text{Number of Sites Visited Claiming to have Measure Installed}^{30}}$$

²⁵ Provided by the Companies.

²⁶ http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B19001&prodType=table

²⁷ Energy Information Administration - [http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey \(RECS\)-b1](http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey (RECS)-b1)

²⁸ Energy Information Administration - [http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey \(RECS\)-b1](http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey (RECS)-b1)

²⁹ Number of sites ADM visited that claimed to have the measure installed and verified the installation.

³⁰ Number of customers that claimed to have the measure installed from the participant survey.

Using data provided by US Census Bureau, the percentage of Ohio households in each zip code per income bracket (P_{zi}) was calculated using Equation 3-22:

$$\%OhioRes_{zi} = \frac{nRes_{zi}}{nRes_z}$$

Equation 3-22

Where:

$\%OhioRes_{zi}$ = Percentage of Ohio residential households in zip code z with income bracket i

$nRes_{zi}$ = Number of Ohio residential households in zip code z with income bracket i ³¹

$nRes_z$ = Total number of Ohio residential households in zip code z ³²

In Equation 3-23 below, the percentage of Ohio residences in zip code z with income bracket i is multiplied by the number of the Companies' residential households in zip code z .

$$P_{zi} = P_z * \%OhioRes_{zi}$$

Equation 3-23

Where:

P_z = the Companies' residential households in zip code z ³³

The tables below (Table 3-3 - Table 3-6) detail the percentage of residences per income bracket who purchased HVAC measures of type t (R_i).

³¹ United States Census Bureau - http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B19001&prodType=table

³² United States Census Bureau - http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

³³ Provided by the Companies.

Table 3-3: Percent of Residences with an CAC Purchase in 2018³⁴

% of Residences that purchased an CAC in 2018 (From Energy Information Administration)					
Income	<20k	20-40k	40-60k	60-100k	>100k
Total (Millions of Units)	8.80	13.00	11.40	12.53	10.41
Number < 2 Yrs. (Millions of Units)	0.65	1.08	1.14	1.12	1.17
Number in 2018(Millions of Units)	0.32	0.54	0.57	0.56	0.59
% Sold 2018	3.67%	4.14%	5.00%	4.46%	5.64%

Table 3-4: Percent of Residences with a Heat Pump Purchase in 2018³⁵

% of Residences that purchased a HP in 2018 (From Energy Information Administration)					
Income	<20k	20-40k	40-60k	60-100k	>100k
Total (Millions of Units)	2.10	2.70	2.60	3.17	2.89
Number < 2 Yrs. (Millions of Units)	0.15	0.22	0.26	0.28	0.33
Number in 2018 (Millions of Units)	0.08	0.11	0.13	0.14	0.16
% Sold 2018	3.67%	4.14%	5.00%	4.46%	5.64%

Table 3-5: Percent of Residences with a Room AC Purchase in 2018³⁶

% of Residences that purchased an AC in 2018 (From Energy Information Administration)					
Income	<20k	20-40k	40-60k	60-100k	>100k
Total (Millions of Units)	7.6	6.8	4.3	4.4	2.6
Number < 2 Yrs. (Millions of Units)	1.2	0.9	0.6	0.5	0.5
Number in 2018 (Millions of Units)	0.6	0.45	0.3	0.25	0.25
% Sold 2018	7.90%	6.62%	6.98%	5.68%	9.62%

³⁴ Energy Information Administration - [http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey \(RECS\)-b1](http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey (RECS)-b1)

³⁵ Energy Information Administration - [http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey \(RECS\)-b1](http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey (RECS)-b1)

³⁶ Energy Information Administration - [http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey \(RECS\)-b1](http://www.eia.gov/consumption/residential/data/2009/#sf?src=<Consumption Residential Energy Consumption Survey (RECS)-b1)

Table 3-6: Percent of Residences with a Dehumidifier Purchase in 2018³⁷

% of Residences that purchased a Dehumidifier in 2018 (From Energy Information Administration)					
	<20	20-40	40-60	60-100	>100
Total (Millions of Units)	24.90	30.10	24.10	27.50	21.80
1 to 3 months (Millions of Units)	0.70	1.30	1.50	1.70	1.40
Number in 2018 (Millions of Units)	0.36	0.65	0.77	0.87	0.72
% Sold 2018	1.45%	2.22%	3.20%	3.18%	3.30%

Climate Factors (CF_z) represent the rate at which climate affects usage and sales of HVAC units type t. They were determined by using EIA data to categorize each zip code as a climate zone. The climate factors are detailed in Table 3-7 - Table 3-9 below, dehumidifiers are calculated using Deemed Savings in (Table 3-10) that do not require a climate factor.

Table 3-7: Climate Factor Central Air Conditioning³⁸

% of Homes w/ Central Air Conditioning in FE Territory (From Energy Information Administration)						
	Total	Very Cold/Cold	Mixed-Humid	Mixed-Dry/Hot-Dry	Hot-Humid	Marine
% of Homes w/ A/C w/o HP	49%	46%	52%	51%	64%	11%
Housing Units Served by Central Air Conditioning Equipment	113.6	38.8	35.4	14.2	19.0	6.3
W/o Heat Pump	56.1	17.7	18.4	7.2	12.1	0.7
W/ Heat Pump	13.5	1.3	6.9	1.4	3.6	0.4
Do Not Have or use Central Air Conditioning Equipment	44.0	19.8	10.1	5.6	3.3	5.2

³⁷ Energy Information Administration - <http://www.eia.gov/consumption/residential/data/2009/#sf?src=<>
Consumption Residential Energy Consumption Survey (RECS)-b1

³⁸ Ibid.

Table 3-8: Climate Factor Heat Pump³⁹

% of Homes w/ Heat Pump in FE Territory (From Energy Information Administration)						
	Total	Very Cold/Cold	Mixed-Humid	Mixed-Dry/Hot-Dry	Hot-Humid	Marine
% of Homes w/ HP	12%	3%	19%	10%	19%	6%
Housing Units Served by Central Air Conditioning Equipment	113.6	38.8	35.4	14.2	19.0	6.3
W/o Heat Pump	56.1	17.7	18.4	7.2	12.1	0.7
W/ Heat Pump	13.5	1.3	6.9	1.4	3.6	0.4
Do Not Have or use Central Air Conditioning Equipment	44.0	19.8	10.1	5.6	3.3	5.2

Table 3-9: Climate Factor Room Air Conditioning⁴⁰

% of Homes w/ Room Air Conditioning in FE Territory (From Energy Information Administration)						
	Total	Very Cold/Cold	Mixed-Humid	Mixed-Dry/Hot-Dry	Hot-Humid	Marine
% of Homes w/ Room AC	23%	30%	24%	16%	15%	16%
Housing Units Served by Central Air Conditioning Equipment	113.6	38.8	35.4	14.1	19.1	6.3
W/Window or Wall Unit	25.9	11.6	8.4	2.2	2.8	1.0

Table 3-10: Deemed Savings Table for Dehumidifiers

HVAC Type	kWh	kW
Dehumidifier	120	0.012

Energy savings per CAC/RAC unit was calculated via Equation 3-24:

$$kWh_{Annual} = \frac{EFLH_{Cool} * Cap * \left[\frac{1}{SEER_{Existing}} - \frac{1}{SEER_{Installed}} \right]}{1000}$$

Equation 3-24

³⁹ Ibid.

⁴⁰ Ibid.

Where:

$EFLH_{Cool}$ = weighted average of effective full load hours per EFLH location by the Companies residential households⁴¹
= 438.83

Cap = Capacity (kBTU)
= Size of the equipment installed
= 34.62⁴²

$SEER_{Existing}$ = SEER efficiency of existing unit
= 10

$SEER_{Installed}$ = SEER efficiency of installed unit
= 14

ADM calculated energy savings per heat pump unit with the following Equation 3-25.⁴³

$$kWh_{Annual} = \frac{EFLH_{Cool} * CAP * \left[\frac{1}{SEER_{Existing}} - \frac{1}{SEER_{Installed}} \right]}{1000} + \frac{EFLH_{Heat} * CAP * \left[\frac{1}{HSPF_{Existing}} - \frac{1}{HSPF_{Installed}} \right]}{1000}$$

Equation 3-25

Where:

$EFLH_{Cool}$ = weighted average of effective full load hours per EFLH location by the Companies' residential households
= 438.83

$EFLH_{Heat}$ = weighted average of effective full load hours per EFLH location by the Companies' residential households
= 1549.10

⁴¹ Weighted average of Run Hours compared to number of residences per location 2010 Ohio Technical Reference Manual, August 6, 2010. Vermont Energy Investment Corporation, pp. 31.

⁴² Weighted average of capacity compared to number sold nationally.
http://www.ahrinet.org/App_Content/ahri/files/Statistics/Monthly%20Shipments/2017/December_2017.pdf

⁴³ 2010 Ohio Technical Reference Manual, August 6, 2010. Vermont Energy Investment Corporation, pp. 33.

Cap	= Capacity (kBTU)
	= Size of the equipment installed
$SEER_{Existing}$	= SEER efficiency of existing unit
	= 13
$SEER_{Installed}$	= SEER efficiency of installed unit
	= 15
$HSPF_{Existing}$	= Heating Season Performance Factor of existing unit
	= 7.7 ⁴⁴
$HSPF_{Installed}$	= Heating Season Performance Factor of installed unit
	= 8.2

The demand (kW) savings is calculated for each HVAC measure (not including dehumidifiers) using Equation 3-26.

$$kW_{Annual} = kWh_{Annual} / (EFLH_{Cool} * CF)$$

Equation 3-26

Where the $CF = 0.5$.

Bottom-Up Approach

ADM corroborated n_{HVAC_t} from the top-down approach and estimated the dehumidifiers ex-post savings by calculating the percent of households in the online survey sample that purchased and installed HVAC during 2018. This was via Equation 3-27.

$$n_{HVAC_t} = \left(\sum \frac{Survey_{HVAC_t}}{\sum Survey_{Participants}} * n_{FE Household} \right) * V - n_{EEprogram HVAC_t}$$

Equation 3-27

Where:

V = Verification Rate
CAC = 56.25%, HP = 50.00%, Room AC = NA⁴⁵, Dehumidifiers = 85%

⁴⁴ 2010 Ohio Technical Reference Manual, August 6, 2010. Vermont Energy Investment Corporation, pp. 67.

⁴⁵ The survey respondents who were part of the field visit pool did not contain any respondents who purchased a Room AC in 2018.

$$= \frac{\text{Number of Sites Visited with Verified Measure Installed}}{\text{Number of Sites Visited Claiming to have Measure Installed}}$$

$n_{EEprogram\ HVAC_t}$ = number of incentivized HVAC measures as part of the 2018 EE Products program

ADM conducted a statistically significant number (184) of field verification visits to verify that the online survey respondents had indeed purchased and installed the energy efficiency measure claimed in the survey. These field visits resulted in verification rates for the survey respondents by measure and were applied to n_{HVAC_t} .

Then n_{HVAC_t} had the total number CAC, HP, Room AC, and Dehumidifiers incentivized through the 2018 EE Products program subtracted out of n_{HVAC_t} for each t . These procedures leave ADM with a statistically valid (90/10) estimate of the number of specific HVAC measures purchased and installed in 2018 that can be attributable to only the CAP program. This count of measures can then be used in Equation 3-24 and Equation 3-25 for the non-dehumidifiers measures to calculate the bottom-up savings. For dehumidifiers, the deemed savings values in Table 3-10 were used to calculate the ex-post energy and demand savings for the 2018 CAP Residential HVAC program.

3.2.2.3 Refrigeration

ADM calculated the energy savings and demand reductions produced by the Companies' residential customers installing energy efficient Refrigerators and Freezers during 2018. ADM developed two analysis approaches to calculate the quantity of residences who purchased refrigerators and freezers in 2018.

- A top-down approach utilizing market research data from EIA and the AHAM sales data. The quantities estimated from this method then had the quantity of measures that were incentivized in the 2018 EE Products program subtracted from the total measure counts. This final measure count of refrigerators and freezers was used in the deemed savings calculation used to corroborate the bottom-up ex-post results.
- A bottom-up approach utilizing primary data collected from the Companies' service territories via online survey was used to extrapolate purchases of refrigerators and freezers to all the Companies customers in 2018. The estimated counts are multiplied by the verification rate identified through the field visits and then have the total measure quantities incentivized in the 2018 EE Products program subtracted out of the measure counts. This final measure count was used in the ex-post deemed savings calculation.

Top-Down Approach

ADM performed an analysis with data provided by FE OH, the United States Census Bureau, market data (EIA), and the AHAM sales data. The AHAM data changed for 2018, in previous years the sales data was available by zip-code but in 2018 only national data was available.

The total annual energy (kWh) savings for Refrigeration appliance type t using Equation 3-28 below.

$$kWhSavingsRef_t = kWh Savings_{Ref_t} * n_{Ref_t}$$

Equation 3-28

Where:

- t = the types of Refrigeration appliance
= Bottom-freezer, top-freezer, and side-by-side
= Upright freezer, chest freezer
- $kWh Savings_{Ref_t}$ = Annual kWh savings per Refrigeration unit type t
- n_{Ref_t} = Number of type t Refrigeration units purchased in 2018 minus the number of incentivized units in the EE Products program

Summing across the annual savings for all refrigeration types t provides the total savings for the residential refrigeration measure.

$$kWhSavingsRef = \sum kWhSavingsRef_t$$

Equation 3-29

Demand savings is calculated similarly to kWh in Equation 3-28 and Equation 3-29 with the $kWh Savings_{Ref_t}$ from Table 3-13 being replaced with $kW Savings_{Ref_t}$ from Table 3-14.

The number of type t Refrigeration units (n_{Ref_t}) purchased in 2018, was calculated by first obtaining the percentage of residential households in Ohio in each zip code per income bracket. Next, the percentage of residential households in each zip code per income bracket that purchased a unit in 2018 was determined, as well as the number of the Companies' residential households in each zip code per income bracket.

The above steps are summarized in Equation 3-30 below:

$$n_{Ref_t} = \sum_z \sum_i P_{zi} * R_i$$

Equation 3-30

Where:

- z = Zip Codes in the Companies' service territories⁴⁶
- i = Income Bracket Levels⁴⁷
- = Annual Income per Residential Household
- = $[0,20,000) \cup [20,000,40,000) \cup [40,000,60,000) \cup [60,000,100,000) \cup [100,000,\infty)$
- P_{zi} = Number of residential households in Zip Code z , with Income Bracket i
- R_i = Percentage of residential households, with income bracket i , with a unit purchased in 2018⁴⁸

Utilizing data provided by US Census Bureau, the percentage of Ohio residential households in each zip code per income bracket (P_{zi}) was calculated using Equation 3-31.

$$\%OhioRes_{zi} = \frac{nRes_{zi}}{nRes_z}$$

Equation 3-31

Where:

- $\%OhioRes_{zi}$ = Percentage of Ohio residential households in zip code z with income bracket i
- $nRes_{zi}$ = Number of Ohio residential households in zip code z with income bracket i ⁴⁹

⁴⁶ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁴⁷ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁴⁸ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁴⁹ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

$nRes_z$ = Total number of Ohio residential households in zip code z ⁵⁰

In Equation 3-32 below, the percentage of Ohio residential households in zip code z with income bracket i is multiplied by the number of the Companies' residential households in zip code z .

$$P_{zi} = P_z * \%OhioRes_{zi}$$

Equation 3-32

Where:

P_z = the Companies' residential households in zip code z ⁵¹

Table 3-11 and Table 3-12 below detail the percentage of residential households per income bracket who purchased refrigeration measures (R_i).

Table 3-11: Percent of Residences that Purchased a Refrigerator in 2018

% of Residences that purchased a Refrigerator in 2018 (From Energy Information Administration)					
Income	<20k	20k-40k	40k-60k	60k-100k	>100k
Total (Millions of Units)	23.80	27.50	21.20	23.60	17.80
Number < 2 Yrs. (Millions of Units)	2.80	2.90	2.60	3.00	2.70
Number in 2018 (Millions of Units)	1.44	1.49	1.34	1.54	1.39
% Sold 2018	6.05%	5.42%	6.31%	6.54%	7.80%

⁵⁰ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁵¹ Provided by the Companies.

Table 3-12: Percent of Residences that Purchased a Freezer in 2018

% of Residences that purchased a Freezer in 2018 (From Energy Information Administration)					
Income	<20k	20k-40k	40k-60k	60k-100k	>100k
Total (Millions of Units)	3.00	4.60	4.00	4.80	3.00
Number < 2 Yrs. (Millions of Units)	0.50	0.60	0.40	0.70	0.60
Number in 2018 (Millions of Units)	0.26	0.31	0.21	0.36	0.31
% Sold 2018 (Millions of Units)	8.57%	6.71%	5.14%	7.50%	10.28%

The annual kWh savings per refrigerator unit type t ($kWh Savings_{Ref_t}$) was derived from the Ohio TRM, and are detailed in the Table 3-13 below:

Table 3-13: Annual Savings for Refrigerators and Freezers

Refrigerator Type	kWh
Bottom Freezer	119
Top Freezer	100
Side by Side	142
Freezer Type	kWh
Chest Freezer	133
Upright Freezer	133

The demand savings was calculated using the following formula:

$$kWSavings_{Ref_t} = kW Savings_{Ref_t} * n_{Ref_t}$$

Equation 3-33

n_{Ref_t} was calculated according to Equation 3-30 and the annual kW savings per refrigerator unit type t ($kW Savings_{Ref_t}$) was derived from the Ohio TRM, and are detailed in Table 3-14 below:

Table 3-14: Refrigerators and Freezers Summer Coincidence Peak Savings

Refrigerator Type	kW
Bottom Freezer	0.021
Top Freezer	0.018
Side by Side	0.025
Freezer Type	kW
Chest Freezer	0.02
Upright Freezer	0.02

Bottom-Up Approach

ADM also calculated n_{Ref_t} using the percent of households in the online survey sample that purchased and installed refrigerators during 2018. This was via Equation 3-34 below and used to calculate savings as shown in Equation 3-28 with the number of incentivized units removed.

$$n_{Ref_t} = \left(\sum \frac{Survey_{Ref_t}}{\sum Survey_{Participants}} * n_{FE Household} \right) * V - n_{EEprogram Ref_t}$$

Equation 3-34

Where:

V = Verification Rate

refrigerators = 88.57%

freezers = 81.25%

= $\frac{\text{Number of Sites Visited with Verified Measure Installed}}{\text{Number of Sites Visited Claiming to have Measure Installed}}$

$n_{EEprogram Ref_t}$ = number of incentivized refrigerators or freezers as part of the 2018 EE Products program

ADM conducted a statistically significant number (184) of field verification visits to verify that the online survey respondents had indeed purchased and installed the energy efficiency measure claimed in the survey. This calculation leaves ADM with a statistically valid (90/10) estimate of the number of specific refrigeration measures purchased and installed in 2018 that can be attributable to CAP.

3.2.2.4 Consumer Electronics

ADM calculated energy savings and demand reductions produced by the Companies' residential customers purchasing energy efficient consumer electronics equipment during 2018. ADM investigated the following consumer electronics measures: Computers,

Computer Monitors, Imaging & Printers and Televisions. ADM estimated the number of ENERGY STAR® qualified units installed in the territories and calculated ex-post savings using a bottom-up approach and a 2016 Energy Star study.⁵² Once the number of electronics were estimated, deemed savings were applied to calculate ex-post savings.

A top-down approach using market data (EIA) and Energy Star shipping data from 2016 and 2017 was used to corroborate the ex-post savings from the bottom-up method.

Top-Down Method

The total annual energy (kWh) savings for Consumer Electronics type t was estimated using the deemed savings approach in Equation 3-35 below.

$$kWhSavingsElec_t = kWhSavings_{Elec_t} * n_{Elec_t}$$

Equation 3-35

Where:

- t = the types of consumer electronics
= Television, Computer, Computer Monitors and Imaging & Printer
- $kWhSavings_{Elec_t}$ = Annual kWh savings per consumer electronics unit type t
- n_{Elec_t} = Number of type t consumer electronics units purchased in 2018 minus the number of incentivized units in the EE products program

Summing across the annual savings for all Consumer Electronics types t provides the total savings for the residential Consumer Electronics measure.

$$kWhSavingsElec = \sum kWhSavingsElec_t$$

Equation 3-36

Demand savings is calculated similarly to kWh in Equation 3-35 and Equation 3-36 with the $kWhSavings_{Elec_t}$ being replaced with $kW Savings_{Elec_t}$.

The number of type t Consumer Electronics units (n_{Elec_t}) purchased in 2018, was calculated two ways, for Computers and Computer Monitors ADM first obtained the percentage of residential households in Ohio in each zip code per income bracket. Next, the percentage of residential households in each zip code per income bracket that

⁵² According to the recent annual household survey conducted by the Consortium of Energy Efficiency (CEE), more than 45% of U.S. households report purchasing an ENERGY STAR certified product in 2015.

purchased a unit in 2018 was determined, as well as the number of the Companies' residential households in each zip code per income bracket.

The above steps are summarized Equation 3-37 in below:

$$n_{Elec_t} = \sum_z \sum_i P_{zi} * R_i$$

Equation 3-37

Where:

- z = Zip Codes in the Companies' service territories⁵³
- i = Income Bracket Levels⁵⁴
- = Annual Income per Residential Household
- = [0,20,000) u [20,000,40,000) u [40,000,60,000) u [60,000,100,000) u [100,000,∞)
- P_{zi} = Number of residential households in Zip Code z , with Income Bracket i
- R_i = Percentage of residential households, with income bracket i , with a unit purchased in 2018⁵⁵

Utilizing data provided by US Census Bureau, the percentage of Ohio residential households in each zip code per income bracket (P_{zi}) was calculated using Equation 3-38.

$$\%OhioRes_{zi} = \frac{nRes_{zi}}{nRes_z}$$

Equation 3-38

Where:

⁵³ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁵⁴ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁵⁵ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

$\%OhioRes_{z_i}$ = Percentage of Ohio residential households in zip code z with income bracket i

$nRes_{z_i}$ = Number of Ohio residential households in zip code z with income bracket i ⁵⁶

$nRes_z$ = Total number of Ohio residential households in zip code z ⁵⁷

In Equation 3-39 below, the percentage of Ohio residential households in zip code z with income bracket i is multiplied by the number of the Companies' residential households in zip code z .

$$P_{z_i} = P_z * \%OhioRes_{z_i}$$

Equation 3-39

Where:

P_z = the Companies' residential households in zip code z ⁵⁸

Table 3-15 and below detail the percentage of residential households per income bracket who purchased refrigeration measures (R_i).

Table 3-15: Percent of Residences that Purchased a Computer in 2018

% of Residences that purchased a Computers in 2018 (From Energy Information Administration)					
Income	<20k	20-40k	40-60k	60-100k	>100k
Total (Millions of Units)	23.80	27.50	21.20	23.40	17.80
Number < hr. (Millions of Units)	2.80	4.10	3.90	3.60	2.20
Number in 2018 (Millions of Units)	1.44	2.11	2.00	1.85	1.13
% Sold 2018	6.05%	7.66%	9.46%	7.91%	6.35%

⁵⁶ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁵⁷ United States Census Bureau - https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B19001&prodType=table

⁵⁸ Provided by the Companies.

Table 3-16: Percent of Residences that Purchased a Computer Monitor in 2018

% of Residences that purchased a Computer Monitor in 2018 (From Energy Information Administration)					
Income	<20k	20-40k	40-60k	60-100k	>100k
Total (Millions of Units)	23.80	27.50	21.20	23.40	17.80
Number < hr. (Millions of Units)	2.80	4.10	3.90	3.60	2.20
Number in 2018 (Millions of Units)	1.44	2.11	2.00	1.85	1.13
% Sold 2018	6.05%	7.66%	9.46%	7.91%	6.35%

For imaging and televisions, the (n_{Elec_t}) measure count was estimated using US Census data and the Energy Star Shipping data from 2016 and 2017. Because the EIA market data did not contain information on imaging and televisions, ADM calculated the percentage (1.46%) of the Companies' households (1,864,635) to total US households (127,590,000) in 2018.

At the time of the M&V analysis for the 2018 CAP, 2018 shipping data had not been released. To estimate the number of imaging and television equipment shipped to retailers in 2018, ADM calculated the % change in shipped units from 2016 to 2017, then applied this percentage to the 2017 numbers. The 2018 shipped measures were then multiplied by the percentage of the Companies' households to get the estimated number of imaging and television equipment purchased in 2018. ADM then subtracted the number of measures incentivized through the EE Products program to get a final estimate of (n_{Elec_t}).

The annual kWh savings per consumer electronic unit type t ($kWh Savings_{Elec_t}$) was derived from the Ohio TRM, and are detailed in the Table 3-17 below:

Table 3-17: Annual Savings for Consumer Electronics

Consumer Electronics Type	kWh
Computer	119
Computer Monitor	24
Television	50
Imaging & Printers	73

The annual kW savings per consumer electronics unit type t ($kW Savings_{Elec_t}$) was derived from the Ohio TRM, and are detailed in Table 3-18 below:

Table 3-18: Consumer Electronics Summer Coincidence Peak Savings

Consumer Electronics Type	kW
Computer	0.0030
Computer Monitor	0.0032
Television	0.0046
Imaging & Printers	0.0098

Bottom-Up Approach

ADM also calculated n_{Ref_t} using the percent of households in the online survey sample that purchased and installed refrigerators during 2018. This was via Equation 3-40 below and used to calculate ex-post savings as shown in Equation 3-35 with the number of incentivized units removed.

$$n_{Elect} = \left(\sum \frac{Survey_{Elect}}{\sum Survey_{Participants}} * n_{FE Households} \right) * V - n_{EEprogram Elect}$$

Equation 3-40

Where:

V = Verification Rate
All Consumer Electronics = 100%
= $\frac{\text{Number of Sites Visited with Verified Measure Installed}}{\text{Number of Sites Visited Claiming to have Measure Installed}}$

$n_{EEprogram Elect}$ = number of incentivized refrigerators or freezers as part of the 2018 EE Products program

ADM conducted a statistically significant number (184) of field verification visits to verify that the online survey respondents had indeed purchased and installed the energy efficiency measure claimed in the survey. This calculation leaves ADM with a statistically valid (90/10) estimate of the number of specific refrigeration measures purchased and installed in 2018 that can be attributable to CAP.

3.3 Detailed Evaluation Findings

During the 2018 residential CAP evaluation, ADM surveyed 3,709 residential customers across all zip codes in the Companies and performed 184 on-site visual verification visits.

3.3.1 Verification of Residential Lighting

Out of the 3,709 online survey sample respondents, 73% indicated that they purchased energy efficient light bulbs during 2018. The site verifications determined that 76.2% of the bulbs reported as purchased during the online survey were in fact installed⁵⁹. The 2018 EE Products lighting program incentivized 2,160,774 LEDs. After accounting for survey answer consistency checks, applying verification rates, removing the estimated EE Products Lighting Program participants and extrapolating to the Companies' service territories, ADM determined the following energy efficient light bulb installations by bulb type in Table 3-19.

Table 3-19: Residential Light Bulb Installations

Bulb Type	Count
Halogen	129,487
CFL	316,016
LED	1,202,646

Table 3-20 below details which rooms survey respondents installed the energy efficient bulbs they purchased in 2018.

⁵⁹ To be counted as "installed", the bulb had to be visually verified and the customer had to verbally confirm the installation date as well as the method of procurement. Bulbs that were either installed during a year other than 2018 or obtained through a utility program were not counted.

Table 3-20: Residential Light Bulb Installations

Location	CFL	LED	Halogen
Basement	7.05%	7.02%	5.40%
Bathrooms	13.75%	12.04%	10.88%
Bedrooms	16.54%	13.62%	12.13%
Den	1.06%	1.71%	1.33%
Dining Room	5.37%	6.56%	3.49%
Entry Way	4.15%	5.21%	5.81%
Garage	5.21%	5.77%	6.89%
Hallway	3.88%	4.96%	3.07%
Kitchen	13.52%	13.59%	17.03%
Living Room	17.20%	13.66%	11.38%
Office	1.49%	2.35%	2.16%
Other Room/Location	0.51%	0.65%	1.33%
Outdoor	4.00%	6.06%	14.12%
Stairway	2.27%	3.48%	1.41%
Store for later installation	4.00%	3.41%	3.57%

Table 3-21 below details which kind of bulbs respondents indicated they replaced with the energy efficient bulbs they purchased in 2018.

Table 3-21: Bulb Replacement Type

Pre-existing Bulb	CFL	LED	Halogen
Incandescent	56.34%	63.44%	51.24%
Halogen	5.03%	5.67%	36.94%
CFL	32.93%	22.72%	8.13%
LED	5.70%	8.18%	3.69%

Table 3-22 below shows the kWh savings calculated during the impact evaluation of residential lighting. Table 3-23 shows the kW reduction.

Table 3-22: Residential Lighting Annual Energy kWh Savings

Measure	CEI	OE	TE	Total
Halogen	209,334	290,742	81,408	581,484
CFL	2,387,891	3,316,516	928,624	6,633,031
LED	13,903,652	19,310,626	5,406,976	38,621,254
Total	16,500,877	22,917,884	6,417,008	45,835,769

Table 3-23: Residential Lighting Summer Peak Coincidence kW Savings

Measure	CEI	OE	TE	Total
Halogen	26.49	36.79	10.30	73.58
CFL	312.75	434.37	121.62	868.74
LED	2,182.38	3,031.09	848.71	6,062.17
Total	2,521.62	3,502.25	980.63	7,004.50

The top-down approach to calculating the residential lighting savings in 2018 resulted in kWh savings that were within 8% of the more conservative total ex-post savings from the bottom-up approach (Table 3-22). Customers were generally willing to participate in the data collection effort and interested in sharing information about their energy efficiency actions/purchasing behaviors. Customers seem relatively familiar with CFL and LED lighting technologies and are comfortable with using them to replace traditional incandescent bulbs.

3.3.2 Verification of Residential HVAC

ADM calculated from the top-down method that 1.3% of the Companies' residential households purchased a central air conditioner, 0.1% a heat pump during the 2018 calendar year and an additional 1.0% purchased a room air conditioner. The savings calculation was performed for a quantity of 25,015 central air conditioner, 2,716 heat pumps, and 18,120 room air conditioners after the units incentivized in the 2018 EE Products program were subtracted.

The savings for dehumidifiers was calculated using the bottom-up method where the online survey had 8% of respondents claiming to have purchased a Energy Star rated dehumidifier in 2018 and 85% of these were verified to be installed in the field visits. Savings calculations were performed on a quantity of 93,866 dehumidifiers.

Table 3-24 shows the kWh savings calculated during the impact evaluation of HVAC. Table 3-25 shows the kW reduction.

Table 3-24: Residential HVAC Savings (kWh) Summary

Measure	CEI	OE	TE	Total
Central Air Conditioners	3,865,977	5,397,164	1,596,344	10,859,485
Room Air Conditioners	60,315	84,204	24,905	169,424
Heat Pumps	561,301	783,614	231,774	1,576,689
Dehumidifiers	4,009,969	5,598,187	1,655,802	11,263,958
Total	8,497,562	11,863,169	3,508,825	23,869,556

Table 3-25: Residential HVAC demand (kW) Summary

Measure	CEI	OE	TE	Total
Central Air Conditioners	4,404.83	6,149.44	1,818.85	12,373.12
Room Air Conditioners	77.41	108.07	31.96	217.44
Heat Pumps	639.53	892.83	264.08	1,796.44
Dehumidifiers	401.00	559.82	165.58	1,126.40
Total	5,522.77	7,710.16	2,280.47	15,513.40

The top-down calculated ex-post savings for all the HVAC measures, excluding dehumidifiers, was 48% lower than the bottom-up analysis for these measures, but was consistent with previous years ex-post savings estimates. Dehumidifier's ex-post savings was calculated using the bottom-up approach and the top-down approach resulted in savings that were within 6% of the ex-post savings.

3.3.3 Verification of Residential Refrigerators and Freezers

Out of the 3,709 online survey sample respondents, ADM identified 472 refrigerators and 178 freezer respondents who completed all survey questions relevant to purchase and installation of energy efficient appliances. For the bottom-up approach, 13.53% and 5.23% of online survey sample respondents reported purchasing and installations were verified at 89% and 81% a refrigerator or freezer (respectively) during the 2018 calendar year.

The savings calculation was performed for a quantity of 219,199 refrigerators and 75,920 freezers determined by the primary data collection effort. These quantities have had the EE Products appliance program incentivized refrigerators (4,327) and freezers (3,323) subtracted from the CAP program counts as described in the methods section above. ADM used the top-down analysis approach to corroborate the primary data analysis. The top-down approach described in the methodology section showed that 6.21% and 7.52% of residences purchased a refrigerator or freezer during the 2018 calendar year. The breakout by refrigerator and freezer type is shown in Table 3-26.

Table 3-26: Installations by Unit Type

Refrigerator Type	Energy Star Quantity Installed	Percent
Bottom-freezer	215	44.15%
Side-by-side	136	27.93%
Top-freezer	136	27.93%
Total	487	100.00%
Freezer Type	Energy Star Quantity Installed	Percent
Chest Freezer	98	52.69%
Upright Freezer	88	47.31%
Total	186	100.00%

Table 3-27 shows the kWh savings calculated during the impact evaluation of refrigerators. Table 3-28 shows the kW reduction.

Table 3-27: Residential Refrigeration kWh Savings

Refrigerator Type	CEI	OE	TE	Total
Bottom-freezer	3,977,128	5,552,339	1,642,241	11,171,708
Side-by-side	2,114,088	2,951,410	872,952	5,938,450
Top-freezer	3,002,005	4,191,001	1,239,592	8,432,598
Total	9,093,221	12,694,750	3,754,785	25,542,756
Freezer Type	CEI	OE	TE	Total
Chest Freezer	1,810,403	2,527,445	747,554	5,085,402
Upright Freezer	1,625,668	2,269,542	671,273	4,566,483
Total	3,436,071	4,796,987	1,418,827	9,651,885
Refrigeration Total	12,529,292	17,491,737	5,173,612	35,194,641

Table 3-28: Residential Refrigeration kW Reduction

Refrigerator Type	CEI	OE	TE	Total
Bottom-freezer	701.85	979.82	289.81	1,971.48
Side-by-side	380.54	531.25	157.13	1,068.92
Top-freezer	528.52	737.85	218.24	1,484.61
Total	1,610.91	2,248.92	665.18	4,525.01
Freezer Type	CEI	OE	TE	Total
Chest Freezer	273.06	381.22	112.75	767.03
Upright Freezer	245.20	342.32	101.25	688.76
Total	518.26	723.52	214.00	1,455.80
Refrigeration Total	2,129.17	2,972.46	879.18	5,980.81

The Bottom-Up approach to calculating the Refrigeration savings in 2018 resulted in ex-post kWh savings that were within 13% of the Top-Down approach.

3.3.4 Verification of Residential Consumer Electronics

Using the bottom-up method ADM calculated 6% of the Companies' residential households purchased a Computer, 3% purchased a Computer Monitor, 6% purchased an Imaging or Printing device and 14% purchased a Television during the 2018 calendar year. The savings calculation was performed for a quantity of 108,582 Computers, 54,773 Computer Monitors, 119,170 Imaging and Printers and 252,200 Televisions. These quantities have had the EE Products appliance program incentivized Televisions (32,623), Computers (2,497), Computer Monitors (3,368) and Imaging and Printers (12,269) subtracted from the CAP program counts. The breakout by consumer electronics is shown in Table 3-29.

Table 3-29: Online Survey Verified Installations of Consumer Electronics

Consumer Electronic Type	Energy Star Quantity Installed	Percent
Computers	221	18.97%
Computer Monitors	116	9.93%
Imaging and Printers	261	22.45%
Televisions	567	48.65%
Total	1,165	100.00%

Table 3-30 shows the kWh savings calculated during the impact evaluation of Consumer Electronics. Table 3-31 shows the kW reduction.

Table 3-30: Residential Consumer Electronics Savings (kWh) Summary

Measure	CEI	OE	TE	Total
Computers	4,599,957	6,421,851	1,899,421	12,921,229
Computer Monitors	467,981	653,333	193,239	1,314,553
Imaging and Printers	3,097,001	4,323,622	1,278,818	8,699,441
Televisions	4,471,206	6,242,104	1,846,256	12,559,566
Total	12,636,145	17,640,910	5,217,734	35,494,789

Table 3-31: Residential Consumer Electronics demand (kW) Summary

Measure	CEI	OE	TE	Total
Computers	115.96	161.90	47.88	325.75
Computer Monitors	58.50	81.67	24.15	164.32
Imaging and Printers	424.25	592.28	175.18	1,191.71
Televisions	448.92	626.71	185.38	1,261.01
Total	1,047.63	1,462.56	432.59	2,942.78

For each consumer electronics measure the differences between the bottom-up based ex-post savings (which was more conservative) and the top-down calculated savings was 1.37% for computers, 1.32% for computer monitors, 9.56% for imaging, and 2.3% for televisions.

3.4 Residential Program Totals

This chapter reports the conclusions resulting from the impact evaluation of the 2018 CAP residential program. The savings by EDC and measure groups are presented in Table 3-32 and Table 3-33.

Table 3-32: kWh by Operating Company

Measure Group	CEI	OE	TE	Total
Res Lighting	16,500,877	22,917,884	6,417,008	45,835,769
Res Refrigerator	12,529,292	17,491,737	5,173,612	35,194,641
Res HVAC	8,497,562	11,863,169	3,508,825	23,869,556
Res Consumer Electronic	12,636,145	17,640,910	5,217,734	35,494,789
Total	50,163,876	69,913,700	20,317,179	140,394,755

Table 3-33: kW by Operating Company

Measure Group	CEI	OE	TE	Total
Res Lighting	2,521.62	3,502.25	980.63	7,004.50
Res Refrigerator	2,129.17	2,972.46	879.18	5,980.81
Res HVAC	5,522.77	7,710.16	2,280.47	15,513.40
Res Consumer Electronics	1,047.63	1,462.56	432.59	2,942.78
Total	11,221.19	15,647.43	4,572.87	31,441.49

The residential portion of the CAP resulted in finding 140,394,755 kWh of annual energy savings and 31,441.49 kW reduction across the three operating Companies.

4 CAP Commercial & Industrial

4.1 Program Description

The primary objective of CAP is to determine the energy savings from the Companies' customers without taking advantage of rebates offered through the Companies' energy efficiency programs. CAP is a Market Research Study in which participants are chosen randomly such that energy savings findings can be extrapolated to the population of businesses within the Companies' service territories.

The C&I CAP quantifies energy savings for the population of the Companies' C&I customers occurring from actions taken outside of a program design. High energy users were omitted from CAP, but all other commercial and industrial businesses are eligible for the program and have the option to opt out or not participate. High energy users were omitted from CAP 2018 due to the high likelihood that they will be participating in the utility sponsored efficiency programs. Furthermore, previous years of CAP have indicated that there is a greater impact on the extrapolated energy savings of non-high energy users. High energy users were businesses with greater than the following average annual energy usage (across 2016 and 2017):

CEI: 1,002,629 kWh

OE: 1,118,187 kWh

TE: 558,103 kWh

Furthermore, only general service (GS) meters were considered. Business customers within the Companies were acquired through the process outlined in Section 2.2.1. Participants were chosen randomly into a stratified sample based on average annual energy usage (kWh). The population considered for CAP included 173,768 businesses. Energy savings were calculated for each business based on the number of energy efficient measures installed during 2018. Energy savings could only be calculated for businesses that could provide the necessary information and documentation to verify the date of installation as well as specifications on the equipment and use.

The energy efficiency measures considered for C&I CAP include: lighting, HVAC, refrigeration, appliances, motors, and other equipment. The category of other includes custom equipment, process equipment, and other measures that are quantifiable by EM&V best practices.

Site level analysis for each business provided the information to calculate annual energy savings (kWh), summer coincident peak savings (kW), and a weighted average estimated useful life for all measures installed in 2018. The site level analyses by stratum were used to extrapolate savings, summer coincident peak savings, and estimated useful life to the

population. Estimated useful life is used to calculate lifetime energy savings (kWh) for the population.

4.1.1 Dual Participation Considerations

To ensure savings verified in the CAP were not originally generated through any other program in the Companies' portfolio offerings, ADM crosschecked participation with the 2018 Mercantile and 2018 C&I program data filtering criteria for the population in which energy savings are to be extrapolated are described in detail in Section 2.2.

4.2 Methodology

ADM'S evaluation of the 2018 C&I CAP consisted of an impact evaluation. The impact evaluation methodology is described in this section.

4.2.1 Sampling Design and Extrapolation Methods

For the C&I portion of the CAP a sample of the population was drawn to generate participants that would provide a +/-10% statistical precision at a 95% confidence level. The sample was drawn randomly to create four strata for each operating company based on average annual energy usage. Due to uncertainties in response rate for the survey, a larger sample was generated. Confidence interval and precision was based on the total of average annual usage (across one or two years) for each stratum compared to the population.

A multiple of the stratified sample was taken to account for the response rate of the survey as well as participant willingness to continue with the program beyond the survey.

4.2.2 Review of Documentation

After respondents agreed to participate in the CAP, documentation was requested by phone and/or email (if necessary). The documentation requested is described in Section 2.2.1. Remaining documentation was collected on-site during the site visit.

4.2.3 On-Site Data Collection Procedures

On-site visits were used to collect data that were essential in calculating savings impacts. The visits to the sites of the sampled projects were used to collect primary data on the facilities participating in the program.

Every business that agreed to participate in the program and responded that they had installed energy efficient equipment was chosen for site visits. Each company was contacted via phone to set up a time for the site visit.

During the on-site visit, the field staff accomplished three major tasks:

1. First, they verified the status of all measures for which customers claimed. They verified that the energy efficiency measures were indeed installed, that they were installed correctly, and that they functioned properly.
2. Second, they collected the physical data needed to analyze the energy savings that have been realized from the installed improvements and measures. Data were collected using a form that was prepared specifically for the project in question after an in-house review of the provided documentation.
3. Third, they interviewed the contact personnel at each facility to obtain additional information on the installed system to complement the data collected from other sources.

When necessary, monitoring was conducted to gather more information on the operating hours of the installed measures. Monitoring was conducted at sites where it was judged that the monitored data would be necessary an accurate calculation of energy savings. Monitoring was not considered necessary for sites where documentation and on-site verification allowed for sufficiently detailed calculations.

4.2.4 Procedures for Estimating Savings from Measures

The method ADM employs to determine savings impacts depends on the types of measures being analyzed. Categories of measures include the following:

- Lighting
- HVAC
- Refrigeration
- Appliances
- Motors
- Other

ADM uses a specific set of methods to determine energy savings for projects that depend on the type of measure being analyzed. For the CAP, the Ohio TRM savings algorithms are utilized first and if additional calculations are necessary, EM&V best practices are used. Typical EM&V methods employed are summarized in Table 4-1.

Table 4-1: Typical Methods to Determine Savings for Custom Measures

Type of Measure	Method to Determine Savings
Lighting	Custom-designed lighting evaluation model, which uses data on wattages before and after installation of measures and hours-of-use data from field monitoring.
HVAC (including packaged units, chillers, cooling towers, controls/EMS)	EQUEST model using DOE-2 as its analytical engine for estimating HVAC loads and calibrated with site-level billing data to establish a benchmark.
Refrigeration	Simulations with EQUEST engineering analysis model, with monitored data.
Motors and VFDs	Measurements of power and run-time obtained through monitoring.
Other	Engineering analysis, with monitored data on load factor and schedule of operation.

Each measure specific energy savings calculation was verified to have not received a rebate from a prescriptive energy efficiency program implemented by the Companies. Projects by measure type were checked against the Mercantile and C&I programs participation in 2018 to avoid any double counting scenarios.

The following discussion describes the basic procedures used for estimating savings from various measure types.

4.2.4.1 Lighting Measures

Lighting measures examined include retrofits of existing fixtures, lamps and/or ballasts with energy efficient fixtures, lamps and/or ballasts. These types of measures reduce demand, while not affecting operating hours. Any proposed lighting control strategies were examined that might include the addition of energy conserving control technologies such as motion sensors or daylighting controls. These measures typically involve a reduction in hours of operation and/or lower current passing through the fixtures.

Analyzing the savings from such lighting measures requires data for retrofitted fixtures on (1) wattages before and after retrofit and (2) hours of operation before and after the retrofit. Fixture wattages were taken from a table of standard wattages, with corrections made for non-operating fixtures. Hours of operation were determined from communications with site contact or metered data collected after measure installation for a sample of fixtures.

To determine baseline and post-retrofit demand values for the lighting efficiency measures, ADM used industry standard data on standard wattages of lighting fixtures and ballasts to determine demand values for lighting fixtures. These data provide information on wattages for common lamp and ballast combinations.

ADM used per-fixture baseline demand, retrofit demand, and appropriate post-retrofit operating hours to calculate peak demand savings and annual energy savings for sampled fixtures of each usage type.

The identified hours of use and the fixture wattages are used to calculate post-retrofit kWh usage. Fixture peak demand is calculated by dividing the total kWh usage calculated peak period of the day by the number of hours in the peak period.

Peak Period Demand Savings are calculated as the difference between peak period baseline demand and post-installation peak period demand of the affected lighting equipment.

The baseline and post-installation peak period demands are calculated by dividing the total kWh usage during the Peak Period by the number of hours in the peak period.

ADM calculated annual energy savings for each sampled fixture per the following formula:

$$\text{Annual Energy Savings} = kWh_{\text{Before}} - kWh_{\text{After}}$$

Equation 4-1

The values for insertion in this formula are determined through the following steps:

- 1) Results from the on-site visit are used to determine if deemed hours of use or as-found hours of use should be applied. The data are extrapolated to develop the annual operating profile of the lighting.
- 2) These average operating hours are then applied to the baseline and post-installation average demand for each usage area to calculate the energy usage and peak period demand for each usage area.
- 3) The annual baseline energy usage is calculated as the sum of the annual baseline kWh for all of the usage areas. The post-retrofit energy usage is calculated similarly. The energy savings are calculated as the difference between baseline and post-installation energy usage.
- 4) Savings from lighting measures in conditioned spaces are factored by the region-specific, building type-specific heating cooling interaction factors to calculate total savings attributable to lighting measures, inclusive of impacts on HVAC operation. These factors are based on the Ohio TRM.

4.2.4.2 HVAC Measures

Savings estimates for HVAC measures installed at a facility are calculated based on the calculations provided in the Ohio TRM or derived by using the energy use estimates developed through DOE-2 simulations. Each simulation produces estimates of HVAC energy and demand usage to be expected under different assumptions about equipment and/or construction conditions. There may be cases in which DOE-2 simulation is

inappropriate because data are not available to properly calibrate a simulation model, and engineering analysis provides more accurate M&V results. For the analysis of HVAC measures, the data collected through on-site visits and monitoring are utilized. Using these data, ADM prepared estimates of the energy savings for the energy efficient equipment and measures installed in each of the participant facilities.

When a simulation was necessary, engineering staff prepared a model calibration run. This is a base case simulation to ensure that the energy use estimates from the simulations have been reconciled against actual data on the building's energy use. This run is based on the information collected in an on-site visit pertaining to types of equipment, their efficiencies and capacities, and their operating profiles. Current operating schedules are used for this simulation, as are local (TMY) weather data covering the study period. The model calibration run is made using actual weather data for a time corresponding to the available billing data for the site.

The goal of the model calibration effort is to have the results of the DOE-2 simulation come within approximately 10% of the patterns and magnitude of the energy use observed in the billing data history. In some cases, it may not be possible to achieve this calibration goal because of idiosyncrasies of facilities (e.g., multiple buildings, discontinuous occupancy patterns, etc.).

Once the analysis model has been calibrated for a particular facility, ADM performs three steps in calculating estimates of energy savings for HVAC measures installed or to be installed at the facility.

1. First, an analysis of energy use at a facility under the assumption that the energy efficiency measures are not installed is performed. If the measure involves replacement of equipment on failure, the required minimum efficiencies given by the appropriate energy efficiency standard would be used. This methodology holds true for all programs/measures being considered.
2. Second, energy use at the facility with all conditions the same but with the energy efficiency measures now installed is analyzed.
3. Third, the results of the analyses from the preceding steps are compared to determine the energy savings attributable to the energy efficiency measure.

4.2.4.3 Refrigeration and Process Improvements

Analysis of savings from refrigeration and process improvements is inherently project-specific; however, savings algorithms from the Ohio TRM, if available, and applicable, are used. Because of the specificity of processes, analyzing the processes through simulations is generally not feasible. Rather, reliance is made on engineering analysis of the process affected by the improvements. Major factors in ADM's engineering analysis of process savings are operating schedules and load factors. Information on these factors is developed through short-term monitoring of the affected equipment, be it

pumps, heaters, compressors, etc. The monitoring is done after the process change, and the data gathered on operating hours and load factors are used in the engineering analysis to define “before” conditions for the analysis of savings. In the case where monitoring is not applicable, detailed information from the site contact is necessary.

4.2.4.4 Appliances

Calculation of energy savings from appliances are derived from the Ohio TRM. This includes refrigerators, washing machines, refrigerated vending machines, and commercial kitchen equipment.

4.2.4.5 Motors

The energy savings from use of high efficiency motors on HVAC and non-HVAC applications are derived from the Ohio TRM. Energy use is measured only for the high efficiency motor and only after it has been installed. The data thus collected are then used in estimating what energy use would have been for the motor application if the high efficiency motor had not been installed. The equivalent full load hours are determined from on-site interviews with the site contact.

4.2.4.6 VFDs

A variable-frequency drive (VFD) is an electronic device that controls the speed of a motor by varying the magnitude of the voltage, current, or frequency of the electric power supplied to the motor. The factors that make a motor load a suitable application for a VFD are (1) variable speed requirements and (2) high annual operating hours. The interplay of these two factors can be summarized by information on the motor's duty cycle, which essentially shows the percentage of time during the year that the motor operates at different speeds. The duty cycle should show good variability in speed requirements, with the motor operating at reduced speed a high percentage of the time.

Potential energy savings from the use of VFDs are usually most significant with variable-torque loads, which have been estimated to account for 50% to 60% of total motor energy use in the non-residential sectors. Energy saving VFDs may be found on fans, centrifugal pumps, centrifugal blowers, and other centrifugal loads, most usually where the duty cycle of the process provided a wide range of speeds of operation.

ADM's approach to determining savings from installation of VFDs involves (1) making one-time measurements of voltage, current, and power factor of the VFD/motor and (2) conducting continuous measurements of amperage over a period of time in order to obtain the data needed to develop VFD load profiles and calculate demand and energy savings. VFDs are generally used in applications where motor loading changes when the motor speed changes. Consequently, the true power drawn by a VFD is recorded to develop VFD load shapes. One-time measurements of power are made for different percent speed settings. Power and percent speed or frequency (depending on VFD display options) are recorded for as wide a range of speeds as the customer allows the

process to be controlled; field staff attempt to obtain readings from 40% to 100% speed in 10% to 15% increments.

4.2.4.7 Other Equipment

Other equipment is considered for energy savings calculations if calculations are provided in the Ohio TRM and the equipment has federally acknowledged standards and practices. Calculation methods for these measures involve custom engineering algorithms from industry standard procedures.

4.2.5 Summer Coincident Peak Savings

Summer coincident peak savings are calculated using the coincidence factors from the Ohio TRM. However, if the as-found annual energy savings (kWh) are higher, then an average value across the summer coincident peak period is used. The summer coincident peak period is defined as 3:00 PM until 6:00 PM on non-holiday weekdays from June 1st until the end of September.

4.2.6 Energy Savings Extrapolation

Energy savings for all measures within a site were added to develop a site level energy savings. A strata level energy savings is determined by summing all the savings within each site in the strata. An energy reduction was determined for each strata by taking the sum of calculated energy savings per strata and dividing by the sum of average annual energy usage.

$$\% \text{ Reduction in Energy Usage} = \Sigma kWh_{\text{Annual Savin}} / \Sigma kWh_{\text{Annual Usage}}$$

Equation 4-2

The percent reduction in annual energy usage from the sample is applied to each site in the population that falls into the same stratum. For each site in the population, the percent reduction in annual energy usage is multiplied by the average annual energy usage for the site to calculate an estimated annual energy savings. Market study level energy savings are then determined by summing all the energy savings of sites within a rate class for each operating company.

The lifetime savings for the population is determined by extrapolating the estimated useful life (EUL) from the sample. A weighted EUL for each site in the sample was determined by the EUL of each measure within the site. The EUL is weighted by the percent of savings provided a measure to the total annual energy savings for the site. An average EUL was then derived for each stratum based on the weighted average EUL for each site. The strata level EUL was applied to each site in the population to determine the lifetime savings for the population. Lifetime savings are reported by rate class for each operating company.

The summer coincident peak savings (kW) was determined for each site based on the calculated summer coincident peak savings for each measure within a site in the sample. The strata level sample kW is the sum of all summer coincident peak savings of sites within the strata. A peak reduction factor is generated by strata by dividing the summer coincident peak savings by the annual energy savings.

$$\text{Summer Coincident Peak kW Savings} = \Sigma kW / \Sigma kWh_{\text{Annual Savings}}$$

Equation 4-3

This peak reduction factor is then applied to each site in the population based on its strata. By multiplying the site-specific annual energy savings by the peak reduction factor, a summer coincident peak savings is generated for each site in the population. Summer coincident peak savings is reported by rate class for each operating company.

4.2.7 Commercial & Industrial Impact Analysis Summary

The methodology described above allows the results of a sample with +/-10% statistical precision at a 95% confidence level to be applied to the population. The calculations extrapolated to the commercial and industrial population are for: annual energy savings (kWh), summer coincident peak savings (kW), and lifetime savings (kWh).

4.3 Detailed Evaluation Findings

4.3.1 Impact Evaluation Findings

This section provides the results of energy savings for the C&I CAP. Upon completion of the interview process, 147 business locations opted to participate in a site visit performed by an ADM field technician or engineer. Of these 147 sites, 110 sites provided all the required documentation to verify installation. Of the 110 sites, 87 installed verified energy efficient equipment in 2018 that resulted in energy savings. Thus, only 23% of business locations with self-claimed energy efficiency measures were able to be verified.

The C&I component of CAP requires a unique evaluation effort because of the recruitment of the sampled respondents. Sample respondents are invited to provide information and supporting documentation for energy efficiency installations that occurred outside of the incentive structure of a utility rebate program. The information collected provides a snapshot of energy efficiency activity based on market conditions.

Since participating in the evaluation process is optional, one of the challenges presented in some cases was acquiring the proper documentation to determine an in-service date and validate installation. Because there was no prior knowledge of an energy efficiency program, some businesses had not retained the invoices or purchases orders required to validate a proof of purchase. Other businesses reported installations in the initial survey

process but opted out of the evaluation process prior to gathering the proof of purchase information.

The documentation validation component of the evaluation plan provided a degree of conservatism to the savings calculations. For example, of the 147 sites that had a site visit performed, 37 provided enough information to estimate savings but not enough to provide substantial proof the measures were installed in 2018. While the remaining sites provided all the required documentation to verify installation, a total of 87 implemented energy efficient equipment that resulted in energy savings.

At a confidence interval of 95%, a relative precision of 3.1% was calculated for the 173,768 general service business customer population. Table 4-2 shows the distribution of businesses in each stratum.

Table 4-2: CAP C&I Sample Precision

Strata	Population Count of Businesses	Sample Count of Businesses	Population Average Annual kWh Usage ⁶⁰	Sample Average Annual kWh Usage
CE01 1	38,918	653	434,357,072	7,650,484
CE01 2	13,203	164	869,590,528	10,536,802
CE01 3	4,769	59	1,063,388,976	13,382,306
CE01 4	2,179	11	1,305,060,308	6,902,710
CE01 5	1,079	0	1,916,718,262	0
CE01 6	117	0	671,687,208	0
OE01 1	49,758	795	402,792,891	6,962,300
OE01 2	22,824	316	913,970,133	12,660,975
OE01 3	9,278	95	1,219,810,590	11,996,276
OE01 4	4,821	29	2,280,201,073	14,133,759
OE01 5	791	0	1,677,977,988	0
OE01 6	1	0	169,584,866	0
TE01 1	15,372	243	135,858,485	2,288,078
TE01 2	6,100	87	258,896,531	3,761,338
TE01 3	2,792	38	343,123,238	5,116,384
TE01 4	1,235	11	409,506,658	3,174,780
TE01 5	418	0	367,514,034	0
TE01 6	113	0	315,971,101	0
Total	173,768	2,501	14,756,009,940	98,566,193
Relative Precision				3.1%

The breakdown of savings in the sample by operating company and measure are shown in Table 4-3. The overall sample annual energy savings are 962,366 kWh.

⁶⁰ Average annual kWh usage: Average daily usage per customer for the 2016 to 08-2018 timespan, multiplied by 365 days.

Table 4-3: CAP C&I Sample Savings (kWh) Summary

Measure	CEI	OE	TE
Lighting	408,269	412,262	110,678
HVAC	8,383	1,181	6,057
Refrigeration	3,594	1,113	3,886
Appliances	0	542	713
Motors	35	0	0
Others	780	4,873	0
Total	421,061	419,971	121,334

4.3.1.1 Verification of Commercial & Industrial Lighting

Out of the 87 sites with verified energy savings in the sample, 75 included lighting measures. Lighting measures included both retrofits and new construction, including controls. Savings values ranged from 0 kWh per year to 137,046 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4-4.

Table 4-4: CAP C&I Sample Lighting Saving

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)
CEI	28	408,269	73.45
OE	37	412,262	77.52
TE	10	110,678	22.77
Total	75	931,209	173.74

4.3.1.2 Verification of Commercial & Industrial HVAC

Out of the 87 sites with verified energy savings in the sample, 10 included HVAC measures. HVAC measures included window AC units, split AC units, room AC units, and heat pump systems. Savings values ranged from 0 kWh per year to 5,323 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4-5.

Table 4-5: CAP C&I Sample HVAC Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)
CEI	5	8,383	7.13
OE	3	1,181	0.15
TE	2	6,057	2.64
Total	10	15,621	9.92

4.3.1.3 Verification of Commercial & Industrial Refrigeration

Out of the 87 sites with verified energy savings in the sample, 9 included refrigeration measures. Refrigeration measures included various types of food storage refrigerators including reach-in freezers, solid door refrigerators, solid door freezers, glass door refrigerators, top freezer refrigerators, and side-by-side refrigerators. Savings values ranged from 0 kWh per year to 3,786 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4-6.

Table 4-6: CAP C&I Sample Refrigeration Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)
CEI	4	3,594	0.43
OE	3	1,113	1.02
TE	2	3,886	0.45
Total	9	8,593	1.89

4.3.1.4 Verification of ENERGY STAR Appliances

Out of the 87 sites with verified energy savings in the sample, 2 included an appliance measure. Appliance measures included clothes washing machines. Savings values ranged from 542 kWh per year to 713 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4-7.

Table 4-7: CAP C&I Sample Appliances Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)
CEI	0	0	0.00
OE	1	542	0.00
TE	1	713	0.00
Total	2	1,255	0.00

4.3.1.5 Verification of Commercial & Industrial Motors

Out of the 87 sites with verified energy savings in the sample, 1 included a motor measure. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4-8.

Table 4-8: CAP C&I Sample Motor Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)
CEI	1	35	0.00
OE	0	0	0.00
TE	0	0	0.00
Total	1	35	0.00

4.3.1.6 Verification of Commercial & Industrial Process and Other Measures

Out of the 87 sites with verified energy savings in the sample, 2 included custom energy efficiency equipment. Custom energy efficiency equipment included VFD and roof insulation. Energy savings for these measures were based on engineering calculations from EM&V best practices. Savings values ranged from 780 kWh per year to 4,873 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4-9.

Table 4-9: CAP C&I Sample Process and Other Measure Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)
CEI	1	780	0.19
OE	1	4,873	0.80
TE	0	0	0.00
Total	2	5,653	0.99

4.3.1.7 Total Energy Savings

The total 2018 annual energy savings from the sampled sites are 962,366 kWh. The total peak demand reduction from the sampled sites are 185.23 kW. Most the energy savings came from lighting projects, representing 97% of the sample energy savings.

Energy savings extrapolation was conducted by applying a rate of energy reduction for each stratum in the sample; which was based on average annual energy usage. Energy savings reduction rates by stratum ranged from 0 to 0.0143. The highest reductions occurred for the stratum with the lowest average annual energy usage for each Company.

Extrapolation to the population of 173,768 general service business locations resulted in annual energy savings of 42,579,059 kWh. Summer coincident peak savings resulted in 8,699.78 kW. A summary of extrapolated energy savings, summer coincident peak savings, and lifetime energy savings is shown in Table 4-10.

Table 4-10: C&I Extrapolated Energy Savings

Strata	Annual Energy Savings (kWh)	Summer Coincident Peak Savings (kW)	Lifetime Savings (kWh)
CEI-GS	19,553,981	4,427.56	241,715,544
OE-GS	16,644,777	2,900.05	158,083,963
TE-GS	6,380,301	1,372.17	80,958,478
Total	42,579,059	8,699.78	480,757,985

5 Appendix A: Required Savings Tables

Tables showing measure-level participation counts and savings for the Program were provided in various locations throughout this report. This appendix provides additional tables summarizing savings results. Lifetime savings were calculated as shown in Equation 5-1.

$$\text{Lifetime Savings} = \text{Measure Life} \times \text{Annualized Savings}$$

Equation 5-1

The annual energy savings from CAP 2018 for both residential and C&I is shown in Table 5-1. The lifetime energy savings from CAP 2018 for both residential and C&I is shown in Table 5-2

Table 5-2.

Table 5-1: Annual kWh & KW Savings by Measure and Operating Company

Program	Company Code	Rate Code	Number of Participants ⁶¹	Annual kWh Savings	Annual kW Savings
CAP C&I	CEI	GS	60,265	19,553,981	4,427.56
	OE	GS	87,473	16,644,777	2,900.05
	TE	GS	26,030	6,380,301	1,372.17
C&I Total			173,768	42,579,059	8,699.78
CAP Residential HVAC	CEI	RS	24,571	8,497,562	5,522.77
	OE	RS	34,303	11,863,169	7,710.16
	TE	RS	10146	3,508,825	2,280.47
	Total		69,020	23,869,556	15,513.40
CAP Residential Refrigeration	CEI	RS	102,332	12,529,292	2,129.17
	OE	RS	123,969	17,491,737	2,972.46
	TE	RS	37,248	5,173,612	879.18
	Total		263,549	35,194,641	5,980.81
CAP Residential Lighting	CEI	RS	719,185	16,500,877	2,521.62
	OE	RS	998,868	22,917,884	3,502.25
	TE	RS	279,683	6,417,008	980.63
	Total		1,997,736	45,835,769	7,004.50
CAP Residential Consumer Electronics	CEI	RS	190,362	12,636,145	1,047.63
	OE	RS	265,758	17,640,910	1,462.56
	TE	RS	78,605	5,217,734	432.59
	Total		534,725	35,494,789	2,942.78
Residential Total			2,865,030	140,394,755	31,441.49
CAP Residential and C&I Total			3,038,798	182,973,814	40,141.27

⁶¹ For the C&I portion of CAP the participants are individual customer buildings. For the residential program, participants are equal to the number of measures identified as part of the CAP program.

Table 5-2: Lifetime kWh Savings by Measure and Operating Company

Program	Company Code	Rate Code	Number of Participants	Lifetime kWh Savings
CAP C&I	CEI	GS	60,265	241,715,544
	OE	GS	87,473	158,083,963
	TE	GS	26,030	80,958,478
C&I Total			173,768	480,757,985
CAP Residential HVAC	CEI	RS	24,571	128,534,413
	OE	RS	34,303	179,442,706
	TE	RS	10,146	53,074,603
	Total		69,020	361,051,722
CAP Residential Refrigeration	CEI	RS	102,332	192,381,541
	OE	RS	123,969	268,577,601
	TE	RS	37,248	79,438,445
	Total		263,549	540,397,587
CAP Residential Lighting	CEI	RS	719,185	220,830,668
	OE	RS	998,868	306,709,261
	TE	RS	279,683	85,878,593
	Total		1,997,736	613,418,522
CAP Residential Consumer Electronics	CEI	RS	190,362	62,583,991
	OE	RS	265,758	87,371,470
	TE	RS	78,605	25,842,266
	Total		534,725	175,797,727
Residential Total			2,865,030	1,690,665,558
CAP Residential and C&I Total			3,038,798	2,171,423,543

6 Appendix B: Survey Instruments

6.1 Residential Survey Instruments

FirstEnergy's Ohio Utilities 2018 Customer Action Program / EE Products Online Survey (Upstream)
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Introduction

Email Introduction

1. Dear [CUSTOMER_NAME],

We are asking for a bit of your time for this survey, on behalf of [UTILITY], regarding household lighting, appliance, and electronics purchases in Ohio. It contains a few questions about light bulbs or appliances you may have purchased for your home in 2018.

If someone else is more familiar with purchasing light bulbs and appliances/electronics for your home, we ask that you please forward this email to that household member.

The survey should only take about ten minutes, and your answers will be completely anonymous. Upon completion of the survey, you will receive an electronic gift card in the amount of \$5.

Survey link:

Password:

Thank you

1. Do you purchase light bulbs, appliances and/or electronics for your home?
 1. Yes, I purchase lights
 2. Someone else does it **[SKIP TO THANK YOU PAGE with text ASKING THE INTRO EMAIL BE FORWARDED TO OTHER PERSON]**
 3. No **[TERMINATE – SKIP TO THANK YOU PAGE (different page than for option (2))]**

Electric Utility and Location Information

2. To ensure your eligibility to participate, we need to determine if you are a customer of one of FirstEnergy's Ohio utilities. What is the name of your electric utility?
- 1. Ohio Edison
 - 2. The Illuminating Company
 - 3. Toledo Edison
 - 97. Other **[Specify]**
 - 98. Don't know

[DISPLAY IF Q2 = 97 OR 98]

3. Based on your electric utility, it does not appear you are eligible for this survey. Thank you for your time and have a nice day. **[TERMINATE – SKIP TO THANK YOU PAGE]**
4. Please provide your zip code.
- 1. _____ **[OPEN]**
 - 98. Don't know

Awareness of Bulb Types

A few questions about your awareness of different types of light bulbs follow. The most common type of CFL is made with a glass tube bent into a spiral. It generally looks like a corkscrew and uses less energy than a typical incandescent light bulb.

5. Have you heard of compact fluorescent light bulbs, or CFLs?
- 1. Yes
 - 2. No
 - 98. Don't know

LED light bulbs are a newer light bulb technology that fit in regular light bulb sockets, but have various appearances. LED bulbs are typically a lot heavier than incandescent bulbs. They use less energy and last much longer than typical incandescent light bulbs.

6. Have you heard of light emitting diode light bulbs, or LEDs?
- 1. Yes
 - 2. No
 - 98. Don't know

Halogen bulbs look similar to incandescent bulbs but are typically marketed using wattage equivalents, which are designed to show the increased energy efficiency of the halogen bulbs compared to the standard incandescent bulbs. For example, the 72 Watt halogen bulb packaging will show a lighting equivalent of a 100 Watt standard incandescent bulb.

7. Have you heard of increased efficiency incandescent bulbs, or halogens?

- 1. Yes
- 2. No
- 98. Don't know

8. Conventional light bulbs are known as incandescent light bulbs. Do you think you could correctly identify the following types of light bulbs, a typical incandescent light bulb, CFL light bulb, LED light bulb, and a halogen light bulb if all four were placed in front of you?

	2. Yes	3. No	4. Don't Know
a. A typical incandescent light	1	2	98
b. CFL light bulb	1	2	98
c. LED light bulb	1	2	98
d. Halogen light bulb	1	2	98

Recent Light Bulb Purchases

A few questions about bulbs you purchased this year follow.

9. In 2018, have you purchased any light bulbs?

- 1. Yes
- 2. No
- 98. Don't know

[IF Q9 = 2 OR 98, SKIP TO Q20]

10. In 2018, about how many light bulbs would you say you have purchased? (Your best estimate is OK.)

- 1. _____ **[OPEN or DROP DOWN]**
- 98. Don't know

11. Have you purchased any compact fluorescent light bulbs, also known as CFLs, during 2018?

- 1. Yes
- 2. No
- 98. Don't know

12. Have you purchased any light emitting diode bulbs, also known as LEDs, during 2018?

- 1. Yes
- 2. No
- 98. Don't know

13. Have you purchased any increased efficiency incandescent bulbs, also known as halogens, during 2018?

- 1. Yes
- 2. No
- 98. Don't know

14. LED fixtures are light fixtures that use LED technology and are wired directly instead of screwed in. They typically have a lower wattage and longer lifespan than equivalent screw in bulbs. Have you purchased any light emitting diode fixtures, also known as LED fixtures, during 2018?

- 1. Yes
- 2. No
- 98. Don't know

15. Have you purchased any occupancy sensors (also known as lighting controls)?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY IF Q11 = 1 OR Q12 = 1 OR Q13 = 1 OR Q14 = 1]

Questions about the number of different bulb types you have purchased in 2018 follow.

16. You mentioned earlier that you have purchased **[INSERT QUANTITY FROM Q10]** light bulbs in 2018. How many of those bulbs were CFLs, LEDs, LED fixtures or halogen bulbs? An example would be 5 CFLs, 5 LEDs, and 5 halogens. (Your best estimate is OK)

Type	Number	
CFLs	DROP DOWN 0-100;	Don't know
LEDs	DROP DOWN 0-100;	Don't know
Halogens	DROP DOWN 0-100;	Don't know
LED Fixtures	DROP DOWN 0-100;	Don't know

17. When did you last purchase each of the following type of lighting.

Type	Last purchase date	Don't Know
CFLs		
LEDs		
Halogens		
LED Fixtures		

[DISPLAY IF Q11 = 1 OR Q12 = 1 OR Q13 = 1 OR Q14 = 1]

18. Were any of the CFLs, LEDs, halogen bulbs, or LED fixtures you purchased in 2018 installed in a business or commercial building?

1. Yes
2. No
98. Don't know

[DISPLAY IF Q18 = 1]

19. Approximately how many of the **[ANSWER FROM Q10]** CFLs, LEDs, Halogens, or LED Fixtures you said you purchased were installed in a business or commercial building?

[Programming note: Only display types with a >0 quantity from Q16. Possibly include that quantity as maximum in a drop down box.]

Type	Number Installed in a Business or Commercial Bldg	Don't Know
CFLs		
LEDs		
Halogens		
LED Fixtures		

Prior Purchases/Program Awareness/Satisfaction

20. Prior to 2018, had you ever purchased CFL light bulbs?

1. Yes
2. No
98. Don't know

21. Prior to 2018, had you ever purchased LED light bulbs?

1. Yes
2. No
98. Don't know

22. Prior to 2018, had you ever purchased halogen light bulbs?

1. Yes
2. No
98. Don't know

23. Prior to 2018, had you ever purchased LED fixtures? LED fixtures are light fixtures that use LED technology and are wired directly instead of screwed in.

1. Yes
2. No
98. Don't know

In-Service Rate

[DISPLAY IF Q11 = 1 OR Q12 = 1 OR Q13 = 1 OR Q14 = 1]

24. Again, you said you purchased **[ANSWER FROM Q10] bulbs** in 2018. How many of those CFLs, LEDs or halogens would you estimate you installed within one week of purchase?

1. _____ **[OPEN or Drop Down].**
2. All of them (100%) **[SKIP TO Q27]**
98. Don't know

[DISPLAY IF Q11 = 1 OR Q12 = 1 OR Q13 = 1 OR Q14 = 1]

25. How many of those CFLs, LEDs or Halogens purchased did you save to install at a later date?

1. _____ **[OPEN or Drop Down]**
2. All of them (100%) **[SKIP TO Q27]**
98. Don't know

26. Approximately how many of the light bulbs you purchased have you not installed? (Your best estimate is okay.)

Type	Number Not Installed	Don't Know
CFLs		
LEDs		
Halogens		
LED Fixtures		

Purchase Reasoning

[DISPLAY IF Q11 = 1]

27. You mentioned you have purchased CFL light bulbs in 2018. When you purchased these CFLs, why did you make the purchase? (Select all that apply)

1. Replaced burned out bulbs
2. Replace working bulbs, wanted to lower energy usage
3. Installed in a new light fixture or lamp socket
4. Improve lighting quality/brighten a room
5. Replaced burned out bulbs & working bulbs at same time
6. Stock up on bulbs
7. Good deal prompted purchase
97. Other (Specify) _____
98. Don't know

[SHOW Q28 – Q33 IF Q12 = 1]

28. You mentioned you have purchased LED light bulbs in 2018. When you purchased these LEDs, why did you make the purchase? (Select all that apply)

1. Replaced burned out bulbs
2. Replace working bulbs, wanted to lower energy usage
3. Installed in a new light fixture or lamp socket
4. Improve lighting quality/brighten a room
5. Replaced burned out bulbs & working bulbs at same time
6. Stock up on bulbs
7. Good deal prompted purchase
8. Promotion of LED bulbs changed my mind
97. Other (Specify) _____
98. Don't know

29. Did you know **[ANSWER Q2]** provides funds to reduce the price of LED bulbs purchased at retail stores?

1. Yes
2. No
98. Don't know

[DISPLAY Q30 - Q31 IF Q29 = 1]

30. How did you learn about the discounted price?

1. Retail Store Signage
2. Retail Store Employee
3. Utility Marketing
4. Friend/Family
5. TV/Radio/Internet Advertising
97. Other (Specify)
98. Don't Know

31. To the best of your knowledge, were the LED bulbs you purchased in 2018 discounted through your utility?

1. Yes
2. No
98. Don't know

32. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the LED bulbs you purchased?

1. Very dissatisfied
2. Dissatisfied
3. Neutral
4. Satisfied

- 5. Very satisfied
- 98. Don't know

33. Have you noticed a difference on your electric bill?

- 1. Yes, I've noticed savings
- 2. No
- 98. Don't know

[DISPLAY IF Q13 = 1]

34. You mentioned you have purchased halogen light bulbs in 2018. When you purchased these halogens, why did you make the purchase? (Select all that apply)

- 1. Replaced burned out bulbs
- 2. Replace working bulbs, wanted to lower energy usage
- 3. Installed in a new light fixture or lamp socket
- 4. Improve lighting quality/brighten a room
- 5. Replaced burned out bulbs & working bulbs at same time
- 6. Stock up on bulbs
- 7. Good deal prompted purchase
- 97. Other (Specify) _____
- 98. Don't know

[DISPLAY IF Q14 = 1]

35. You mentioned you have purchased LED fixtures in 2018. When you purchased these LED fixture, why did you make the purchase? LED fixtures are light fixtures that use LED technology and are wired directly instead of screwed in. (Select all that apply)

- 1. Replaced burned out bulbs
- 2. Replace working bulbs, wanted to lower energy usage
- 3. Installed in a new light fixture or lamp socket
- 4. Improve lighting quality/brighten a room
- 5. Replaced burned out bulbs & working bulbs at same time
- 6. Stock up on bulbs
- 7. Good deal prompted purchase
- 97. Other (Specify) _____
- 98. Don't know

36. Did you know **[ANSWER Q2]** provides funds to reduce the price of LED fixtures purchased at retail stores?

- 1. Yes
- 2. No

98. Don't know

[DISPLAY Q37 - Q38 IF Q36 = 1]

37. How did you learn about the discounted price?

- 1. Retail Store Signage
- 2. Retail Store Employee
- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't Know

38. To the best of your knowledge, were the LED fixtures you purchased in 2018 discounted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

39. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the LED fixtures you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

40. Have you noticed a difference on your electric bill?

- 1. Yes, I've noticed savings
- 2. No
- 98. Don't know

Bulb Types Replaced

[DISPLAY Q41 - Q46 IF Q11 = 1]

41. Earlier you mentioned you purchased new CFL's in 2018, how many were installed in your home?

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

42. In which of the following locations did you install the CFLs? (Select all that apply)

1. Bedrooms
2. Bathrooms
3. Living Room
4. Kitchen
5. Entry Way
6. Dining Room
7. Garage
8. Basement
9. Den
10. Stairway
11. Office
12. Hallway
13. Outdoor
14. Store for later installation
97. Other Room/Location (Specify)
97. Other Room/Location (Specify)
98. Don't know

43. How many of the new CFLs replaced standard incandescent bulbs?

1. _____ [OPEN or Drop Down]
2. **None**
98. Don't know

44. How many of the new CFLs replaced halogens?

1. _____ [OPEN or Drop Down]
2. **None**
98. Don't know

45. How many of the new CFLs replaced old CFLs?

1. _____ [OPEN or Drop Down]
2. **None**
98. Don't know

46. How many of the new CFLs replaced LEDs?

1. _____ [OPEN or Drop Down]
2. **None**
98. Don't know

[DISPLAY Q47 – Q52 IF Q12 = 1]

47. Earlier you mentioned you purchased new LED's in 2018, how many were installed in your home?

1. _____ [OPEN or Drop Down]

- 2. None
- 98. Don't know

48. In which of the following locations do you install the LEDs? (Select all that apply)

- 1. Bedrooms
- 2. Bathrooms
- 3. Living Room
- 4. Kitchen
- 5. Entry Way
- 6. Dining Room
- 7. Garage
- 8. Basement
- 9. Den
- 10. Stairway
- 11. Office
- 12. Hallway
- 13. Outdoors
- 14. Store for later installation
- 97. Other Room/Location (Specify)
- 98. Don't know

49. How many of the new LEDs replaced standard incandescent bulbs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

50. How many of the new LEDs replaced halogens?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

51. How many of the new LEDs replaced CFLs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

52. How many of the new LEDs replaced old LEDs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

[DISPLAY Q53 – Q58 IF Q13 = 1]

53. Earlier you mentioned you purchased new Halogens in 2018, how many were installed in your home?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

54. In which of the following locations do you install the Halogens? (Select all that apply)

- 1. Bedrooms
- 2. Bathrooms
- 3. Living Room
- 4. Kitchen
- 5. Entry Way
- 6. Dining Room
- 7. Garage
- 8. Basement
- 9. Den
- 10. Stairway
- 11. Office
- 12. Hallway
- 13. Outdoors
- 14. Store for later installation
- 97. Other Room/Location (Specify)
- 97. Other Room/Location (Specify)
- 98. Don't know

55. How many of the new Halogens replaced standard incandescent bulbs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

56. How many of the new Halogens replaced old Halogens?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

57. How many of the new Halogens replaced CFLs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

58. How many of the new Halogens replaced LEDs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None

98. Don't know

[DISPLAY Q59 – Q64 IF Q14 = 1]

59. Earlier you mentioned you purchased new LED fixtures in 2018, how many were installed in your home?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

60. In which of the following locations did you install the LED fixtures? (Select all that apply)

- 1. Bedrooms
- 2. Bathrooms
- 3. Living Room
- 4. Kitchen
- 5. Entry Way
- 6. Dining Room
- 7. Garage
- 8. Basement
- 9. Den
- 10. Stairway
- 11. Office
- 12. Hallway
- 13. Outdoors
- 14. Store for later installation
- 97. Other Room/Location (Specify)
- 97. Other Room/Location (Specify)
- 98. Don't know

61. How many of the new LED fixtures replaced fixtures with standard incandescent bulbs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

62. How many of the LED fixtures replaced fixtures with Halogens?

- 1. _____ **[OPEN or Drop Down]**
- 2. None
- 98. Don't know

63. How many of the new LED fixtures replaced fixtures with CFLs?

- 1. _____ **[OPEN or Drop Down]**
- 2. None

98. Don't know

64. How many of the new LED fixtures replaced fixtures with old LEDs?

1. _____ **[OPEN or Drop Down]**

2. None

98. Don't know

[DISPLAY IF Q11 = 1 OR Q12 = 1 OR Q13 = 1 OR Q14 = 1]

65. Of the light bulbs you purchased in 2018, were any of them purchased through any of the following retail stores:

1. The Home Depot

2. Lowes Home Improvement

3. Sam's Club

4. Walmart

5. Costco

6. Sears

7. Hartville Hardware

97. Other (Specify)

98. Don't know

Lighting Controls

[DISPLAY Q66 IF Q15 =1]

66. Did you install the occupancy sensors you indicated you purchased?

1. Yes

2. No

98. Don't know

[DISPLAY Q67 IF Q66 =1]

67. What is the wattage of the fixture being controlled by the occupancy sensor?

1. _____ **[Open or Drop Down]**

98. Don't know

Appliance Basics

68. Since January 1, 2018, have you purchased or had installed ANY of the following items in your home/residence: Refrigerator, Freezer, Dehumidifier, Room Air Conditioner, High-Efficiency Central Air Conditioner, Heat Pump or Mini-Split Heat Pump?

Q.	Appliance	Yes	No	DK	
a.	Refrigerator	1	2	98	
b.	Freezer	1	2	98	
c.	Dehumidifier	1	2	98	

d.	Room Air Conditioner	1	2	98	
e.	Central AC	1	2	98	
f.	Heat Pump	1	2	98	
g.	Mini-Split Heat Pump	1	2	98	

Refrigerator

[DISPLAY Q69– Q81 IF Q68a = 1]

69. What kind of refrigerator model did you purchase?

- 1. Top-freezer refrigerator model
- 2. Bottom-freezer refrigerator model
- 3. Side-by-side refrigerator model
- 98. Don't know

70. Was the refrigerator you purchased ENERGY STAR® certified?

- 1. Yes
- 2. No
- 98. Don't know

71. Do you remember the month in 2018 when you purchased the refrigerator?

- 1. _____ **[DROP DOWN]**
- 98. Don't know

72. Was this refrigerator purchased:

- 1. To replace a functioning unit
- 2. To replace a broken unit
- 3. Not a replacement
- 98. Don't know

[DISPLAY IF Q73 = 2]

73. Why didn't you repair the broken unit?

- 1. Too costly
- 2. Too much time involved
- 3. Wanted to change style
- 98. Don't know

[DISPLAY IF Q72 = 1 or 2]

74. What did you do with your old unit?

1. Still have it, not in use
2. Recycled the unit
3. Took it to the dump
4. Sold it for scrap metal
5. Sold for parts
6. Sold or gifted unit to an individual
7. Sold or donated to an organization/company
97. Other (Specify)
98. Don't know

[DISPLAY IF Q74 = 7]

75. Please provide the organization/company that received the donation:

1. _____ [OPEN]
98. Don't know

76. For the refrigerator you bought, was it purchased through any of the following retail stores:

1. The Home Depot
2. Lowes Home Improvement
3. Sam's Club
4. Walmart
5. Costco
6. Sears
7. Hartville Hardware
97. Other (Specify)
98. Don't know

77. Did you know **[ANSWER Q2]** provides funds to reduce the price of refrigerators purchased at retail stores?

1. Yes
2. No
98. Don't know

[DISPLAY Q78 - Q79 IF Q77 = 1]

78. How did you learn about the discounted price?

- 1. Retail Store Signage
- 2. Retail Store Employee
- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't Know

79. To the best of your knowledge, was the refrigerator you purchased in 2018 discounted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

80. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the refrigerator you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

81. Have you noticed a difference on your electric bill?

- 1. Yes, I've noticed savings
- 2. No
- 98. Don't know

Freezer

[DISPLAY Q82 - Q94 IF Q68b = 1]

82. What kind of freezer model did you purchase?

- 1. Chest freezer, with the lid on top
- 2. Upright Freezer, with the door on the front
- 98. Don't know

83. Was the freezer you purchased Energy Star certified?

- 1. Yes
- 2. No
- 98. Don't know

84. Do you remember the month in 2018 when you purchased the freezer?

- 1. _____ **[DROP DOWN]**
- 98. Don't know

85. Was this freezer purchased:

- 1. To replace a functioning unit
- 2. To replace a broken unit
- 3. Not a replacement
- 98. Don't know

[DISPLAY IF Q85 = 2]

86. Why didn't you repair the broken unit?

- 1. Too costly
- 2. Too much time involved
- 3. Wanted to change style
- 98. Don't know

[DISPLAY IF Q85 = 1 or 2]

87. What did you do with your old unit?

- 1. Still have it, not in use
- 2. Recycled the unit
- 3. Took it to the dump
- 4. Sold it for scrap metal
- 5. Sold for parts
- 6. Sold or gifted unit to an individual
- 7. Sold or donated to an organization/company
- 97. Other (Specify)
- 98. Don't know

[DISPLAY IF Q87 = 7]

88. Please provide the organization/company that received the donation:

- 1. _____ **[OPEN]**
- 98. Don't know

89. For the freezer you bought, was it purchased through any of the following retail stores:

- 1. The Home Depot
- 2. Lowes Home Improvement
- 3. Sam's Club
- 4. Walmart

- 5. Costco
- 6. Sears
- 7. Hartville Hardware
- 97. Other (Specify)
- 98. Don't know

90. Did you know **[ANSWER Q2]** provides funds to reduce the price of freezers purchased at retail stores?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q91 - Q92 IF Q90= 1]

91. How did you learn about the discounted price?

- 1. Retail Store Signage
- 2. Retail Store Employee
- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't Know

92. To the best of your knowledge, was the freezer you purchased in 2018 discounted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

93. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the freezer you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

94. Have you noticed a difference on your electric bill?

- 1. Yes, I've noticed savings
- 2. No
- 98. Don't know

Dehumidifier

[DISPLAY Q95 – Q104 IF Q68c = 1]

95. Was the dehumidifier you purchased ENERGY STAR® certified?

- 1. Yes
- 2. No
- 98. Don't know

96. Do you remember the month in 2018 when you purchased the dehumidifier?

- 1. _____ **[DROP DOWN]**
- 98. Don't know

97. Was this dehumidifier purchased:

- 1. To replace a functioning unit
- 2. To replace a broken unit
- 3. Not a replacement
- 98. Don't know

[DISPLAY IF Q97 = 2]

98. Why didn't you repair the broken unit?

- 1. Too costly
- 2. Too much time involved
- 3. Wanted to change style
- 98. Don't know

99. For the dehumidifier you bought, was it purchased through any of the following retail stores:

- 1. The Home Depot
- 2. Lowes Home Improvement
- 3. Sam's Club
- 4. Walmart
- 5. Costco
- 6. Sears
- 7. Hartville Hardware
- 97. Other (Specify)
- 98. Don't know

100. Did you know **[ANSWER Q2]** provides funds to reduce the price of dehumidifiers purchased at retail stores?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q101 - Q102 IF Q100 = 1]

101. How did you learn about the discounted price?

- 1. Retail Store Signage
- 2. Retail Store Employee
- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't know

102. To the best of your knowledge, was the dehumidifier you purchased in 2018 discounted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

103. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the dehumidifier you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

104. Have you noticed a difference on your electric bill?

- 1. Yes, I've noticed savings
- 2. No
- 98. Don't know

Room Air Conditioner

[DISPLAY Q105 - Q111 IF Q68d = 1]

We have questions about your new room air conditioner that may require you to look at the appliance. Details sought include: **Make/Manufacturer; BTUs (capacity)**

105. What was the make or manufacturer of the room air conditioner you purchased? The make or manufacturer should be listed on the unit. (Please look at the room air conditioner)

- 1. _____ **[OPEN]**
- 98. Don't know

106. What is the capacity of the unit in BTUs? (Please look at the room air conditioner)

- 1. _____ [OPEN]
- 98. Don't know

107. Was the room AC you purchased Energy Star certified?

- 1. Yes
- 2. No
- 98. Don't know

108. Which month in 2018 was the air conditioner installed?

- 1. _____ [DROP DOWN]
- 98. Don't know

109. Was this air conditioner purchased:

- 1. To replace a functioning unit
- 2. To replace a broken unit
- 3. Not a replacement
- 98. Don't know

[DISPLAY IF Q109 = 2]

110. Why didn't you repair the broken unit?

- 1. Too costly
- 2. Too much time involved
- 3. Wanted to change style
- 98. Don't know

[DISPLAY IF Q109 = 1 or 2]

111. What did you do with your old unit?

- 1. Still have it, not in use
- 2. Recycled the unit
- 3. Took it to the dump
- 4. Sold it for scrap metal
- 5. Sold for parts
- 6. Sold or gifted unit to an individual
- 7. Sold or donated to an organization/company
- 97. Other (Specify)
- 98. Don't know

[DISPLAY IF Q111 = 7]

112. Please provide the organization/company that received the donation:

- 1. _____ [OPEN]

98. Don't know

113. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the room air conditioner you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

High-Efficiency Central Air Conditioner

[DISPLAY Q114 - Q126 IF Q68e = 1]

We have questions about your new central air conditioner that may require you to look at the appliance. Details sought include: **Make/Manufacturer; BTUs (capacity); SEER rating**

114. Which month in 2018 did you purchase the central air conditioning system?

- 1. _____ [DROP DOWN]
- 98. Don't know

115. Please provide the make or manufacturer of the central air conditioning system you purchased. The make or manufacturer should be listed on the outdoor unit. (Please look at the central air conditioner)

- 1. _____ [OPEN]
- 98. Don't know

116. Was the central air conditioning system you purchased Energy Star certified?

- 1. Yes
- 2. No
- 98. Don't know

117. What is the capacity of the unit in BTU/hr? (Please look at the central air conditioner)

- 1. _____ [OPEN or Drop Down]
- 98. Don't know

118. What is the SEER rating of the NEW unit? (Please look at the central air conditioner)

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

119. Do you recall the SEER rating of the OLD unit? If so, please enter below:

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

[DISPLAY Q120 IF Q119 = 98]

120. Do you recall the age of the OLD unit?

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

121. Can you tell me the name of the contractor who installed the new unit?

- 1. _____ **[OPEN]**
- 2. Did not use contractor
- 98. Don't know

122. Was this air conditioner purchased:

- 1. To replace a functioning unit
- 2. To replace a broken unit
- 3. Not a replacement
- 98. Don't know

[DISPLAY IF Q122 = 2]

123. Why didn't you repair the broken unit?

- 1. Too costly
- 2. Too much time involved
- 3. Wanted to change style
- 98. Don't know

[DISPLAY IF Q122 = 1 or 2]

124. What did you do with your old unit?

- 1. Still have it, not in use
- 2. Recycled the unit
- 3. Took it to the dump
- 4. Sold it for scrap metal
- 5. Sold for parts
- 6. Sold or gifted unit to an individual
- 7. Sold or donated to an organization/company
- 97. Other (Specify)
- 98. Don't know

[DISPLAY IF Q124 = 7]

125. Please provide the organization/company that received the donation:

- 1. _____ [OPEN]
- 98. Don't know

126. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the central AC you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

Heat Pump

[DISPLAY Q127 – Q0 IF Q68f = 1]

We have questions about your new heat pump that may require you to look at the appliance. Details sought include: **Make/Manufacturer; BTUs (capacity); SEER rating**

127. Which month in 2018 did you purchase the heat pump?

- 1. _____ [DROP DOWN]
- 98. Don't know

128. Please provide the make or manufacturer of the heat pump you purchased.
(Please look at the heat pump)

- 1. _____ [OPEN]
- 98. Don't know \

129. Was the heat pump you purchased Energy Star certified?

- 1. Yes
- 2. No
- 98. Don't know

130. What is the capacity of the unit in BTU/hr.? (Please look at the heat pump)

- 1. _____ [OPEN or Drop Down]
- 98. Don't know

131. What is the SEER rating of the NEW unit? (Please look at the heat pump)

- 1. _____ [OPEN or Drop Down]
- 98. Don't know

132. Do you recall the SEER rating of the OLD unit?
- 1. _____ **[OPEN or Drop Down]**
 - 98. Don't know

[DISPLAY IF Q132 = 98]

133. Do you recall the age of the OLD unit?
- 1. _____ **[OPEN or Drop Down]**
 - 98. Don't know

134. Can you tell me the name of the contractor who installed the new unit?
- 1. _____ **[OPEN]**
 - 2. Did not use contractor
 - 98. Don't know

135. Was this heat pump purchased:
- 1. To replace a functioning unit
 - 2. To replace a broken unit
 - 3. Not a replacement
 - 98. Don't know

136. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the heat pump you purchased?
- 1. Very dissatisfied
 - 2. Dissatisfied
 - 3. Neutral
 - 4. Satisfied
 - 5. Very satisfied
 - 98. Don't know

Mini-Split Heat Pump

[DISPLAY Q137 – Q145 IF Q68g = 1]

We have questions about your new mini-split heat pump that may require you to look at the appliance. Details sought include: **Make/Manufacturer; BTUs (capacity); SEER rating**

137. Which month in 2018 did you purchase the mini-split heat pump?
- 1. _____ **[DROP DOWN]**
 - 98. Don't know

138. Can you tell me the make or manufacturer of the mini-split heat pump you purchased? (Please look at the mini heat pump)

- 1. _____ **[OPEN]**
- 98. Don't know

139. Was the mini-split heat pump you purchased Energy Star certified?

- 1. Yes
- 2. No
- 98. Don't know

140. What is the capacity of the unit in BTU/hr? (Please look at the mini heat pump)

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

141. What is the SEER rating of the NEW unit? (Please look at the mini heat pump)

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

142. Do you recall the SEER rating of the OLD unit?

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

[DISPLAY IF Q142 = 98]

143. Do you recall the age of the OLD unit?

- 1. _____ **[DROP DOWN]**
- 98. Don't know

144. Can you tell me the name of the contractor who installed the new unit?

- 1. _____ **[OPEN]**
- 2. Did not use contractor
- 98. Don't know

145. Was this mini-split heat pump purchased:

- 1. To replace a functioning unit
- 2. To replace a broken unit
- 3. Not a replacement
- 98. Don't know

146. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the mini-split heat pump you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

Household Electronics

147. Since January 1, 2018, have you purchased or had installed ANY of the following items in your home/residence: Computer, Computer Monitor, Digital Imaging or Printers, a TV less than 40 inches, or a TV that is 40 inches or larger?

Q.	Appliance	Yes	No	DK	
a.	Computer	1	2	98	
b.	Computer Monitor	1	2	98	
c.	Imaging or printers	1	2	98	
d.	TV, less than 40 inches	1	2	98	
e.	TV, 40 inches or larger	1	2	98	

Computers

[DISPLAY Q148 – Q153 IF Q147a = 1]

148. Are you currently using the computer you purchased?

- 1. Yes
- 2. No
- 98. Don't know

149. For the computer you bought, was it purchased through any of the following retail stores:

- 1. Sam's Club
- 2. Walmart
- 3. Costco
- 4. Sears
- 5. Best Buy
- 97. Other (Specify)
- 98. Don't know

150. Did you know **[ANSWER Q2]** provides funds to promote energy efficient computers purchased at retail stores?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q151 to Q152 if Q150 = 1]

151. How did you learn about the promotion?

- 1. Retail Store Signage
- 2. Retail Store Employee
- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't Know

152. To the best of your knowledge, was the computer you purchased in 2018 promoted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

153. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the computer you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

Computer Monitors

[DISPLAY Q154 – Q159 IF Q147b = 1]

154. Are you currently using the computer monitor you purchased?

- 1. Yes
- 2. No
- 98. Don't know

155. For the computer monitor you bought, was it purchased through any of the following retail stores:

1. Sam's Club
2. Walmart
3. Costco
4. Sears
5. Best Buy
97. Other (Specify)
98. Don't know

156. Did you know **[ANSWER Q2]** provides funds to promote energy efficient computer monitors purchased at retail stores?

1. Yes
2. No
98. Don't know

[DISPLAY Q157 - Q158 IF Q156= 1]

157. How did you learn about the promotion?

1. Retail Store Signage
2. Retail Store Employee
3. Utility Marketing
4. Friend/Family
5. TV/Radio/Internet Advertising
97. Other (Specify)
98. Don't Know

158. To the best of your knowledge, was the computer monitor you purchased in 2018 promoted through your utility?

1. Yes
2. No
98. Don't know

159. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the computer monitor you purchased?

1. Very dissatisfied
2. Dissatisfied
3. Neutral
4. Satisfied
5. Very satisfied
98. Don't know

Imaging, Printers, and Scanners

[DISPLAY Q160 – Q165 IF Q147c = 1]

160. Are you still using the printer or other imaging device you purchased?

- 1. Yes
- 2. No
- 98. Don't know

161. For the printer or other imaging device you bought, was it purchased through any of the following retail stores:

- 1. Sam's Club
- 2. Walmart
- 3. Costco
- 4. Sears
- 5. Best Buy
- 97. Other (Specify)
- 98. Don't know

162. Did you know **[ANSWER Q2]** provides funds to promote energy efficient imaging devices purchased at retail stores?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q163 - Q164 IF Q162 = 1]

163. How did you learn about the promotion?

- 1. Retail Store Signage
- 2. Retail Store Employee
- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't Know

164. To the best of your knowledge, was the printer or imaging device you purchased in 2018 promoted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

165. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the printer or imaging device you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

TVs less than 40"

[DISPLAY Q166 – Q171 IF Q147d = 1]

166. Did you install the TV smaller than 40 inches you purchased?

- 1. Yes
- 2. No
- 98. Don't know

167. For the TV smaller than 40 inches you bought, was it purchased through any of the following retail stores:

- 1. Sam's Club
- 2. Walmart
- 3. Costco
- 4. Sears
- 5. Best Buy
- 97. Other (Specify)
- 98. Don't know

168. Did you know **[ANSWER Q2]** provides funds to promote energy efficient TVs purchased at retail stores?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q169 - Q170 if Q168= 1]

169. How did you become aware of the promotion?

- 1. Retail Store Signage
- 2. Retail Store Employee
- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't Know

170. To the best of your knowledge, was the TV you purchased in 2018 promoted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

171. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the TV you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

[DISPLAY Q172– Q177 IF Q147e = 1]

TVs 40" or greater

172. Did you install the TV 40 inches or greater you purchased?

- 1. Yes
- 2. No
- 98. Don't know

173. For the TV 40 inches or greater, was it purchased through any of the following retail stores:

- 1. Sam's Club
- 2. Walmart
- 3. Costco
- 4. Sears
- 5. Best Buy
- 97. Other (Specify)
- 98. Don't know

174. Did you know **[ANSWER Q2]** provides funds to promote energy efficient TVs purchased at retail stores?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q175 - Q176 IF Q174 = 1]

175. How did you learn about the promotion?

- 1. Retail Store Signage
- 2. Retail Store Employee

- 3. Utility Marketing
- 4. Friend/Family
- 5. TV/Radio/Internet Advertising
- 97. Other (Specify)
- 98. Don't Know

176. To the best of your knowledge, was the TV you purchased in 2018 promoted through your utility?

- 1. Yes
- 2. No
- 98. Don't know

177. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the TV you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

Smart Thermostat

178. Did you purchase a Smart Thermostat in 2018? Smart thermostat models include Nest, ecobee, Honeywell, LUX, and Emerson models.

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q179 – Q186 IF Q178 = 1]

179. Did you install the Smart Thermostat you purchased?

- 1. Yes
- 2. No
- 98. Don't know

180. On a scale of 1-5, where 1 means very dissatisfied and 5 means very satisfied, how satisfied or dissatisfied you are with the smart thermostat you purchased?

- 1. Very dissatisfied
- 2. Dissatisfied
- 3. Neutral
- 4. Satisfied
- 5. Very satisfied
- 98. Don't know

181. Have you noticed a difference on your electric bill?

- 1. Yes, I've noticed savings
- 2. No
- 98. Don't know

182. What kind of AC unit do you have?

- 1. Room Air Conditioner
- 2. Central AC
- 3. Heat Pump
- 4. Mini-Split Heat Pump
- 98. Don't know

183. What kind of heating unit do you have?

- 1. Electric Furnace
- 2. Gas Furnace
- 3. Heat Pump
- 98. Don't know

184. Do you recall the SEER rating of the A/C unit?

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

185. Do you recall the age of the A/C unit?

- 1. _____ **[OPEN or Drop Down]**
- 98. Don't know

186. What type of thermostat is your Smart Thermostat replacing?

- 1. Manual
- 2. Programmable
- 98. Don't know

Household Characteristics / Demographics

A few of questions about your home and income level follow. These are anonymous and will be used solely for the purpose of combining different customers' responses. You can choose to not answer any of these questions.

Please answer the following questions about the house, apartment, or mobile home you reside in.

187. Which best describes this building? Include all apartments, flats, etc., even if vacant.

- 1. A mobile home
- 2. A one-family house detached from any other house
- 3. A one-family house attached to one or more houses

- 4. A building with 2 apartments
- 5. A building with 3 or 4 apartments
- 6. A building with 5 to 9 apartments
- 7. A building with 10 to 19 apartments
- 8. A building with 20 to 49 apartments
- 9. A building with 50 or more apartments
- 10. Boat, RV, van, etc.
- 98. Don't know

188. Please select one of the following. Is this house, apartment, or mobile home:

- 1. Owned by you or someone in this household with a mortgage or loan? Include home equity loans?
- 2. Owned by you or someone in this household free and clear (without a mortgage or loan)?
- 3. Rented?
- 4. Occupied without payment of rent?
- 98. Don't know

189. About when was this building first built?

- 1. 2000 or later
- 2. 1990 to 1999
- 3. 1980 to 1989
- 4. 1970 to 1979
- 5. 1960 to 1969
- 6. 1950 to 1959
- 7. 1940 to 1949
- 8. 1939 or Earlier
- 98. Don't know

[DISPLAY IF Q189= 1]

190. You indicated the building was built in 2000 or later. Please provide the exact year.

- 1. _____ **[OPEN OR Drop Down]**
- 98. Don't know

191. Approximately how many square feet is your home?

- 1. _____ **[OPEN]**
- 98. Don't know

192. How many separate rooms are there in this house, apartment or mobile home? Include bedrooms, kitchens, etc. Exclude bathrooms, porches, foyers, halls or unfinished basements.

- 1. _____ **[OPEN or Drop Down]**

98. Don't know

193. How many of those rooms are bedrooms? Count as bedrooms those rooms you would list if this house, apartment, or mobile home were for sale or rent. (For an efficiency/studio apartment please record "0")

1. _____ **[OPEN or Drop Down]**

98. Don't know

194. How many people are living or staying at this address?

Include everyone who is living or staying here for more than 2 months. Include yourself if you are living or staying here for more than 2 months. Include anyone else staying here who does not have another place to stay, even if they are here for less than two months. Do not include anyone who is living somewhere else for more than two months, such as a college student living away or someone in the Armed Forces on deployment.

1. _____ **[OPEN or Drop Down]**

98. Don't know

195. When did the person who owns or leases this house, apartment or mobile home move in? Please provide a month and year.

1. Month _____ **[OPEN or Drop Down]**

2. Year _____ **[OPEN or Drop Down]**

98. Don't know

196. Which fuel is used MOST for heating this house, apartment, or mobile home?

1. Gas: from underground pipes serving the neighborhood

2. Gas: stored liquid petroleum gas (propane/butane)

3. Electricity

4. Fuel oil, kerosene, etc.

5. Coal

6. Wood

7. Solar energy

8. Other fuel

9. No fuel used

98. Don't know

197. In the past 12 months, what was the cost in dollars of oil, coal, kerosene, wood, etc., for this house, apartment, or mobile home? If you have lived here less than 12 months, estimate the cost for an entire year.

1. \$ _____ **[OPEN or Drop Down]**

98. Don't know

198. What is your approximate total household income?

1. Less than \$18,000
2. \$18,000 to less than \$25,000
3. \$25,000 to less than \$31,000
4. \$31,000 to less than \$38,000
5. \$38,000 to less than \$44,000
6. \$44,000 to less than \$51,000
7. \$51,000 to less than \$57,000
8. \$57,000 to less than \$64,000
9. \$64,000 to less than \$70,000
10. \$70,000 to less than \$77,000
11. \$77,000 to less than \$83,000
12. \$83,000 to less than \$90,000
13. \$90,000 or more
98. Don't know

Customer Information

Thank you for your time in answering questions regarding lighting and appliance purchases in Ohio. We are finished at this time. Upon verification that you are a customer of FirstEnergy's Ohio utilities, we would like to provide you with a \$5 gift card. To do that, we will need your name and an email address where we can send you a link to your gift card.

1. First Name and Last Name: _____
2. Email Address: _____

190. Would you allow us to contact you again to schedule a household visit to document the energy saving measures you described? You would receive an additional \$20 gift card if you are selected and participate in the home visit.

1. Yes
2. No

[DISPLAY Q191 & Q192 IF Q190 = 1]

191. What is the best way to contact you about scheduling the home verification visit if your home is selected, via phone or email? Please enter a phone number or email address

If Telephone preferred, please enter: _____
If Email preferred, please enter: _____

192. What day of the week and time would work best for you?

1. Day: _____ [RECORD RESPONSE]
2. Time: _____ [RECORD RESPONSE]

98. Don't Know

You should be receiving an email with the link to your gift card in 10 days or less. If you have any questions regarding this survey or would like to know the status of your gift card, please send an email to adm-surveys2018@admenergy.com. Once again thank you for participating in this survey regarding household lighting and appliance purchases in Ohio. Have a great day!

[PROGRAM NOTE: INCLUDE THANK YOU PAGE REQUESTING OTHER HOUSEHOLD MEMBER]

[PROGRAM NOTE: INCLUDE THANK YOU PAGE for those who aren't eligible].

[PROGRAM NOTE: INCLUDE THANK YOU PAGE for those who aren't eligible].

6.2 Commercial & Industrial Survey Instruments

FirstEnergy's Ohio Utilities

2018 C&I Customer Action Program

Participant Survey

PREDEFINED VARIABLES

Variables	Definitions
STRATUM	Stratum of business
ID	Identification
UTILITY	EDC
ADDRESS	Address of business
NAICS Group	NAICS group # of business
INTERVIEWER NAME	Name of person conducting survey
COMPANY NAME	Name of business

TELEPHONE INTRODUCTION

1. Hello, my name is [INTERVIEWER NAME] and I am calling with ADM Associates on behalf of [UTILITY]. This is not a sales call. We are conducting energy research regarding equipment purchased for your business in 2018. Your business will be compensated for full participation in this study. May I speak with someone who is familiar with equipment purchases made for the facility at [COMPANY NAME]?

[IF NEEDED: We are contracted on behalf of ADM Associates, which is a professional service corporation providing comprehensive energy program evaluations, evaluations of emerging technologies, market assessments, and energy program portfolio development support.]

1. Yes, you are speaking with the correct person.
2. No, is there another person that I can speak that in regard to this program **[WHEN REFERRED TO A NEW CONTACT, RECORD CONTACT INFO IN COMMENT BOX, THEN REPEAT THIS QUESTION WITH NEW CONTACT. REPEAT THIS PROCESS UNTIL APPROPRIATE CONTACT HAS BEEN REACHED]**
3. No **[SKIP TO UU]**

Comments: _____

[Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "1"]

[RESPONDENT IDENTIFICATION OPTIONS; SUPERVISOR, OPERATIONS MANAGER, MAINTENANCE MANAGER]

[MEASURE TYPE IDENTIFICATION OPTIONS; MOTORS, PUMPS, LIGHTING (SUCH AS LED FIXTURES)]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "2"

[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR, OPERATIONS MANAGER, BUSINESS MANAGER, ENGINEERING MANAGER, MAINTENANCE MANAGER]

[MEASURE TYPE IDENTIFICATION OPTIONS; MOTORS, PUMPS, LIGHTING (SUCH AS LED FIXTURES), HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS)]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "3"

[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR, OPERATIONS MANAGER, BUSINESS MANAGER, ENGINEERING MANAGER, MAINTENANCE MANAGER]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "4"

[RESPONDENT IDENTIFICATION OPTIONS; STORE MANAGER, MANAGER ON DUTY]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES), REFRIGERATION]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "5"

[RESPONDENT IDENTIFICATION OPTIONS; SUPERVISOR, OPERATIONS MANAGER, MAINTENANCE MANAGER]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES), REFRIGERATION]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "6"

[RESPONDENT IDENTIFICATION OPTIONS; BUSINESS MANAGER, MAINTENANCE MANAGER, SUPERVISOR]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES)]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "7"

**[RESPONDENT IDENTIFICATION OPTIONS; BUILDING MANAGER,
MAINTENANCE MANAGER, FACILITIES SUPERVISOR]**

**[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS
(SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES)]**

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "8"

**[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR,
ENGINEERING MANAGER, PURCHASER]**

**[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS
(SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES)]**

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "9"

**[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR,
ENGINEERING MANAGER, MAINTENANCE MANAGER]**

**[MEASURE TYPE IDENTIFICATION OPTIONS; LIGHTING (SUCH AS LED
FIXTURES), HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS),
MOTORS]**

A. Interview

2. I would like to start by asking if your company has installed any of the following energy efficiency measures in 2018: lighting, refrigeration (including freezers and ice makers), HVAC systems or components, clothes washers and other appliances, or electric motors or motor variable frequency drives (VFDs).
 1. Yes, have installed
 2. No, have not installed **[SKIP TO UU]**
 3. No, I don't want to take the survey **[SKIP TO UU]**

3. Great, would you be willing to answer a few questions about your company's experience purchasing or installing new equipment? This survey should take approximately 10 minutes of your time and we would like to provide compensation in exchange for the survey, a short visit to your business to gather information, collection of documentation, and proof of purchase regarding the equipment you have installed. By completing a W-9, your business will be paid based on energy savings calculations from industry experts using information and documentation provided by your business. Your business will receive a check from \$100 to a maximum of \$1,000 for a completed survey and in-person visit.

1. Yes
2. No **[SKIP TO UU]**

4. What is the total area in square feet of the building or buildings your business occupies?

1. Square feet:
98. Don't know
99. Refused

5. What percentage of that space are you responsible for? [NUMERIC OPEN END: 1-100; 9998 = DON'T KNOW; 9999 = REFUSED]

6. What are your normal operating hours? [Fill in each day of the week with the typical daily schedule; If closed on certain days, leave those days blank]

1. Monday:
2. Tuesday:
3. Wednesday:
4. Thursday:
5. Friday:
6. Saturday:
7. Sunday:
98. Don't know
99. Refused

7. Are there any holidays when your facility is closed? [Select all that apply; Read only if needed]

1. New Year's Day
2. Martin Luther King Jr. Day
3. President's Day
4. Good Friday
5. Easter Sunday
6. Memorial Day
7. Independence Day (Fourth of July)
8. Labor Day
9. Columbus Day
10. Veterans' Day
11. Thanksgiving Day
12. Day after Thanksgiving (Family Day)
13. Rosa Parks Day
14. Christmas Eve
15. Christmas Day
16. Not closed for any holidays
97. Other (Specify): _____
98. Don't know
99. Refused

8. Are there any months when your business is closed? [Select all that apply; Fill in each month with the days the business is closed; If not closed during a particular month, leave blank]

1. January:
2. February:
3. March:
4. April:
5. May:
6. June:
7. July:
8. August:

- 9. September:
- 10. October:
- 11. November:
- 12. December:
- 13. Not closed for any months of the year
- 97. Don't know
- 98. Refused

9. Please classify your facility type as one of the following: [Prompt if necessary; Read only as needed]

- 1. Food Sales
- 2. Food Service
- 3. Health Care
- 4. Hotel/Motel
- 5. Office
- 6. Public Assembly
- 7. Public Services (non-food)
- 8. Retail
- 9. Warehouse
- 10. School
- 11. College
- 12. Industrial
- 13. Garage
- 97. Other (Specify): _____

B. Installed Measures

10. What is/are the energy efficiency measures that you have installed in 2018? [IF RESPONSE IS GENERAL, E.G., "LIGHTING EQUIPMENT", PROBE FOR SPECIFIC MEASURES FROM LIST. IF NECESSARY, READ THE POSSIBLE CATEGORIES BELOW] [Select all that apply]

- 1. Lighting
- 2. HVAC: Packaged air conditioners, heat pumps, or heaters
- 3. Refrigeration and freezers
- 4. Clothes Washers or other appliances

- 5. Motors or VFDs
- 6. Did not implement any measures **[SKIP TO UU]**
- 97. Other equipment
- 98. Don't know **[DO NOT READ]**
- 99. Refused **[DO NOT READ]**

[SHOW Q11 – Q162 IF Q10 = 1, SKIP TO U]

C. Lighting Verification

The next few questions will be about the lighting equipment that you installed or replaced.

11. What types of lighting upgrades did you implement? [Read options; Select all that apply]

- 1. Linear fluorescent light fixtures (for example T8 or T12 fluorescent lamps)
- 2. Compact fluorescent lamps (CFLs)
- 3. LED light fixtures
- 4. Metal halide lamps
- 5. Ceiling fan light kits
- 6. High intensity discharge (HID) lamps
- 7. LED exit signs
- 8. Incandescent reflector lamps
- 9. Occupancy sensors
- 10. Didn't install any lighting equipment
- 97. Other (Specify): _____
- 98. Don't know **[DO NOT READ]**
- 99. Refused **[DO NOT READ]**

[SHOW IF Q11 =1]

D. Linear Fluorescents

12. How many linear fluorescents, for example T5s or T8s, did you install?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

13. When did you install the linear fluorescents? [If more than one piece of equipment installed, enter earliest date only]
14. What is the wattage of the linear fluorescents you installed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]
15. And are these linear fluorescents installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?
- 1. Inside
 - 2. Outside
 - 3. Refrigerated space
 - 97. Other (Specify): _____
 - 98. Don't know
 - 99. Refused

[SHOW IF Q15 = 1]

16. Is the inside space heated, cooled, or both?
- 1. Heated
 - 2. Cooled
 - 3. Both
 - 98. Don't know
 - 99. Refused
17. Did the linear fluorescents replace existing equipment?
- 1. Yes
 - 2. No
 - 98. Don't know
 - 99. Refused

[SHOW IF Q17 = 1]

18. What equipment did the linear fluorescents replace?
- 1. Linear fluorescent light T12
 - 2. Linear fluorescent light T8
 - 3. Incandescent

- 4. CFL
- 5. Metal Halide
- 97. Other (Specify): _____
- 98. Don't know
- 99. Refused

[SHOW IF Q18 = 1]

19. How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 1]

20. What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 2]

21. How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 2]

22. What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 3]

23. How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 3]

24. What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 4]

25. How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 4]

26. What is the wattage of the CFLs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 5]

27. How many metal halides did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 5]

28. What is the wattage of the metal halides that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 97]

E. Linear Fluorescent Replace Other

29. How many [Q18 Other: Specify] did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q18 = 97]

30. What is the wattage of the [Q18 Other: Specify] that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q31 – Q49 IF Q11 = 2, SKIP TO H]

F. Compact Fluorescent Lamps (CFLs)

31. How many compact fluorescent lamps, also known as CFLs, did you install?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

32. When did you install the CFLs? [If more than one piece of equipment installed, enter earliest date only]

33. What is the wattage of the CFLs you installed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

34. And are these CFLs installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

- 1. Inside
- 2. Outside
- 3. Refrigerated space
- 97. Other (Specify)
- 98. Don't know
- 99. Refused

[SHOW IF Q34 = 1]

35. Is the inside space heated, cooled, or both?

- 1. Heated
- 2. Cooled
- 3. Both
- 98. Don't know
- 99. Refused

36. Did the CFLs replace existing equipment?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[IF Q36 = 2, 98, OR 99, SKIP TO H]

37. What equipment did the CFLs replace?

- 1. Linear fluorescent light T12
- 2. Linear fluorescent light T8
- 3. Incandescent
- 4. CFL
- 5. Metal Halide
- 97. Other (Specify): _____
- 98. Don't know

99. Refused

[SHOW IF Q37 = 1]

38. How many T12s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 =1]

39. What is the wattage of the T12s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 2]

40. How many T8s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 =2]

41. What is the wattage of the T8s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 3]

42. How many incandescent bulbs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 3]

43. What is the wattage of the incandescent bulbs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 4]

44. How many CFLs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 4]

45. What is the wattage of the CFLs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 5]

46. How many metal halides did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 5]

47. What is the wattage of the metal halides that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 97]

G. CFLs Replace Other

48. How many [Q37 Other: Specify] did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q37 = 97]

49. What is the wattage of the [Q37 Other: Specify] that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q50 – Q69 IF Q11= 4, SKIP TO J]

H. LED Light Fixtures

50. How many light emitting diode fixtures, also known as LEDs, did you install?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

51. When did you install the LEDs? [If more than one piece of equipment installed, enter earliest date only]

52. What is the wattage of the LEDs you installed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

53. What type of LEDs did you install? [READ CATEGORIES IF NECESSARY]

1. General Purpose
2. Reflector
3. Tube LEDs that replace linear fluorescent bulbs
4. LED Metal Halide replacements
5. Fixtures
6. Other

7. Don't know [DO NOT READ]

8. Refused [DO NOT READ]

54. And are these LEDs installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

1. Inside

2. Outside

3. Refrigerated space

97. Other (Specify): _____

98. Don't know

99. Refused

[SHOW IF Q54 = 1]

55. Is the inside space heated, cooled, or both?

1. Heated

2. Cooled

3. Both

98. Don't know

99. Refused

56. Did the LEDs replace existing equipment?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q56 = 2, 98, OR 99, SKIP TO J]

57. What equipment did the LEDs replace?

1. Linear fluorescent light T12

2. Linear fluorescent light T8

3. Incandescent

4. CFL

5. Metal Halide

97. Other (Specify): _____

98. Don't know

99. Refused

[SHOW IF Q57 = 1]

58. How many T12s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 1]

59. What is the wattage of the T12s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 2]

60. How many T8s did you remove?

NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 2]

61. What is the wattage of the T8s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 3]

62. How many incandescent bulbs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 3]

63. What is the wattage of the incandescent bulbs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 =4]

64. How many CFLs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 4]

65. What is the wattage of the CFLs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 5]

66. How many metal halides did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q57 = 5]

67. What is the wattage of the metal halides that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q68 - Q69 IF Q57 = 97]

I. LEDs Replace Other

68. How many [Q57 Other: Specify] did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

69. What is the wattage of the [Q57 Other: Specify] that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q70 – Q88 IF Q11 = 5, SKIP TO L]

J. Metal Halide Lamps

70. How many metal halide(s) did you install?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

71. When did you install the metal halides? [If more than one piece of equipment installed, enter earliest date only]

72. What is the wattage of the metal halide(s) you installed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

73. And are these metal halide(s) installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

1. Inside

2. Outside

3. Refrigerated space

97. Other (Specify): _____

98. Don't know

99. Refused

[SHOW IF Q73 = 1]

74. Is the inside space heated, cooled, or both?

- 1. Heated
- 2. Cooled
- 3. Both
- 98. Don't know
- 99. Refused

75. Did the metal halide(s) replace existing equipment?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[IF Q75 = 2, 98, OR 99, SKIP TO L]

76. What equipment did the metal halide(s) replace?

- 1. Linear fluorescent light T12
- 2. Linear fluorescent light T8
- 3. Incandescent
- 4. CFL
- 5. Metal Halide
- 97. Other (Specify): _____
- 98. Don't know
- 99. Refused

[SHOW IF Q76 = 1]

77. How many T12s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 1]

78. What is the wattage of the T12s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 2]

79. How many T8s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 2]

80. What is the wattage of the T8s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 3]

81. How many incandescent bulbs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 3]

82. What is the wattage of the incandescent bulbs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 4]

83. How many CFLs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 4]

84. What is the wattage of the CFLs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 5]

85. How many metal halides did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q76 = 5]

86. What is the wattage of the metal halides that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q87 - Q88 IF Q76 = 97]

K. Metal Halide Replace Other

87. How many [Q76 Other: Specify] did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

88. What is the wattage of the [Q76Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q89 – Q107 IF Q11 = 8, SKIP TO N]

L. Incandescent Reflector Lamps

89. How many incandescent reflector lamps did you install?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

90. When did you install the incandescent reflector lamps? [If more than one piece of equipment installed, enter earliest date only]

91. What is the wattage of the incandescent reflector lamps you installed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

92. And are these incandescent reflector lamps installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

1. Inside

2. Outside

3. Refrigerated space

97. Other (Specify): _____

98. Don't know

99. Refused

[SHOW IF Q92 = 1]

93. Is the inside space heated, cooled, or both?

1. Heated

2. Cooled

3. Both

98. Don't know

99. Refused

94. Did the incandescent reflector lamps replace existing equipment?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q94 = 2, 98, OR 99, SKIP TO N]

95. What equipment did the incandescent reflector lamps replace?

1. Linear fluorescent light T12
2. Linear fluorescent light T8
3. Incandescent
4. CFL
5. Metal Halide

97. Other (Specify): _____

98. Don't know

99. Refused

[SHOW IF Q95 = 1]

96. How many T12s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 1]

97. What is the wattage of the T12s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 2]

98. How many T8s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 2]

99. What is the wattage of the T8s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 3]

100. How many incandescent bulbs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 3]

101. What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 4]

102. How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 4]

103. What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 5]

104. How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q95 = 5]

105. What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q106 - Q107 IF Q95 = 97]

M. Incandescent Reflector Lamps Other

106. How many [Q95 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

107. What is the wattage of the [Q95 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q108 – Q124 IF Q11 = 5, SKIP TO P]

N. Ceiling Fan Lights

108. How many ceiling fan lights did you install?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

109. When did you install the ceiling fan lights? [If more than one piece of equipment installed, enter earliest date only]

110. What is the wattage of the ceiling fan lights you installed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

111. Did the ceiling fan lights replace existing equipment?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[IF Q111 = 2, 98, OR 99, SKIP TO P]

112. What equipment did the ceiling fan lights replace?

- 1. Linear fluorescent light T12
- 2. Linear fluorescent light T8
- 3. Incandescent
- 4. CFL
- 5. Metal Halide
- 97. Other (Specify): _____
- 98. Don't know
- 99. Refused

[SHOW IF Q112 = 1]

113. How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112 = 1]

114. What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112 = 2]

115. How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112 = 2]

116. What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112 = 3]

117. How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112 = 3]

118. What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112 = 4]

119. How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112= 4]

120. What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112 = 5]

121. How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q112= 5]

122. What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q123 – Q124 IF Q112 = 97]

O. Ceiling Fan Replace Other

123. How many [Q112 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

124. What is the wattage of the [Q112 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q125 - Q141 IF Q11 = 6, SKIP TO R]

P. High Intensity Discharge Lamps

125. How many high intensity discharge lamps, also known as HIDs, did you install?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

126. When did you install the HID lamps? [If more than one piece of equipment installed, enter earliest date only]

127. What is the wattage of the HID lamps you installed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

128. Did the HID lamps replace existing equipment?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q128 = 2, 98, OR 99, SKIP TO R]

129. What equipment did the HID lamps replace?

1. Linear fluorescent light T12

2. Linear fluorescent light T8

3. Incandescent

4. CFL

5. Metal Halide

97. Other (Specify): _____

98. Don't know

99. Refused

[SHOW IF Q129 = 1]

130. How many T12s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 1]

131. What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 2]

132. How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 2]

133. What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 3]

134. How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 3]

135. What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 4]

136. How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 4]

137. What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 5]

138. How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q129 = 5]

139. What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q140 - Q141 IF Q129 = 97]

Q. HID Replace Other

140. How many [Q129 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]
141. What is the wattage of the [Q129 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q142 – Q162 IF Q11 = 7, SKIP TO T]

R. LED Exit Signs

142. When did you install the LED exit signs? [If more than one piece of equipment installed, enter earliest date only]
143. Were the LED exit signs single sided, double sided, or a combination of the two sign types?
1. Single sided
 2. Double sided
 3. Some single and some double sided
 4. Electroluminescent
97. Other (Specify): _____
98. Don't know
99. Refused

[SHOW Q144 – Q162 IF Q11= 97, SKIP TO U]

S. Other Energy Saving Lighting Measures

144. How many [Q11 Other: Specify] did you install?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]
145. When did you install the [Q11 Other: Specify]? [If more than one piece of equipment installed, enter earliest date only]
146. What is the wattage of the [Q11 Other: Specify] you installed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

147. And are these [Q11 Other: Specify] installed inside, outside, or in a refrigerated space?

- 1. Inside
- 2. Outside
- 3. Refrigerated space
- 97. Other (Specify): _____
- 98. Don't know
- 99. Refused

[SHOW IF Q147 = 1]

148. Is the inside space heated, cooled, or both?

- 1. Heated
- 2. Cooled
- 3. Both
- 98. Don't know
- 99. Refused

149. Did the [Q11 Other: Specify] replace existing equipment?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[IF Q149 = 2, 98, OR 99, SKIP TO U]

150. What equipment did the [Q11 Other: Specify] replace?

- 1. Linear fluorescent light T12
- 2. Linear fluorescent light T8
- 3. Incandescent
- 4. CFL
- 5. Metal halide
- 97. Other (Specify): _____
- 98. Don't know

99. Refused

[SHOW IF Q150 = 1]

151. How many T12s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 1]

152. What is the wattage of the T12s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 2]

153. How many T8s did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 2]

154. What is the wattage of the T8s that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 3]

155. How many incandescent bulbs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 3]

156. What is the wattage of the incandescent bulbs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 4]

157. How many CFLs did you remove?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 4]

158. What is the wattage of the CFLs that you removed?

[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 5]

159. How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW IF Q150 = 5]

160. What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q161 – Q162 IF Q150 = 97]

T. Other Lighting Measures Replace Other

161. How many [Q150 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]
162. What is the wattage of the [Q150 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998 = DON'T KNOW; 9999 = REFUSED]

[SHOW Q163 – Q242 IF Q10 = 2, SKIP TO DD]

U. HVAC Verification

The next few questions will be about the HVAC equipment that you installed or replaced.

163. What types of equipment did you install as part of the HVAC project?
[Select all that apply]
- 1. Split Air Conditioning System
 - 2. Packaged Air Conditioning System
 - 3. Ductless Mini Split
 - 4. Air Source Heat Pump
 - 5. Geothermal/Ground Source Heat Pump
 - 6. Air Cooled Chiller
 - 7. Water Cooled Chiller
 - 8. Didn't install any HVAC equipment
 - 97. Other (Specify): _____
 - 98. Don't know

99. Refused

[SHOW Q164 – Q173 IF Q163 = 1]

V. Split Air Conditioning System

164. When did you install the split air conditioning system? [If more than one piece of equipment installed, enter earliest date only]

165. What is the capacity of the split air conditioning system? [Capture either in tons or in Btu/hr]

1. Tons:

2. Btu/hr:

98. Don't know

99. Refused

[IF Q165 = 1 OR 2, SKIP TO Q167]

166. How many square feet does the split air conditioning system serve?

1. Square feet:

98. Don't know

99. Refused

167. What is the SEER of the split air conditioning system?

1. SEER:

98. Don't know

99. Refused

[IF Q167 = 1, SKIP TO Q169]

168. What is the EER of the split air conditioning system?

1. EER:

98. Don't know

99. Refused

169. Did the split air conditioning system replace old equipment?

1. Yes

- 2. No
- 98. Don't know
- 99. Refused

[SHOW IF Q169 = 1]

170. How old was the replaced equipment?

- 1. 0 - 4 years
- 2. 5 - 9 years
- 3. 10 - 14 years
- 4. 15 - 19 years
- 5. 20 years or older
- 98. Don't know
- 99. Refused

171. What is the primary fuel source for heating?

- 1. Natural Gas
- 2. Electricity
- 3. Propane
- 97. Other (Specify): _____
- 98. Don't know
- 99. Refused

172. What is the temperature set-point of the heated space for heating?
[Record response in units indicated by the respondent]

- 1. Heating set-point Fahrenheit:
- 2. Heating set-point Celsius:
- 98. Don't know
- 99. Refused

173. What is the temperature set-point of the conditioned space for cooling?
[Record response in units indicated by the respondent]

- 1. Cooling set-point Fahrenheit:
- 2. Cooling set-point Celsius:
- 98. Don't know

99. Refused

[SHOW Q174 – Q183 IF Q163 = 2]

W. Packaged Air Conditioning System

174. When did you install the packaged air conditioning system? [If more than one piece of equipment installed, enter earliest date only]

175. What is the capacity of the packaged air conditioning system? [Capture either in tons or in Btu/hr]

1. Tons:

2. Btu/hr:

98. Don't know

99. Refused

[IF Q175 = 1 OR 2, SKIP TO Q177]

176. How many square feet does the packaged air conditioning system serve?

1. Square feet:

98. Don't know

99. Refused

177. What is the SEER of the packaged air conditioning system?

1. SEER:

98. Don't know

99. Refused

[IF Q177 = 1, SKIP TO Q179]

178. What is the EER of the packaged air conditioning system?

1. EER:

98. Don't know

99. Refused

179. Did the packaged air conditioning system replace old equipment?

1. Yes

- 2. No
- 98. Don't know
- 99. Refused

[IF Q179 = 2, 98, OR 99, SKIP TO Q181]

180. How old was the replaced equipment?

- 1. 0 - 4 years
- 2. 5 - 9 years
- 3. 10 - 14 years
- 4. 15 - 19 years
- 5. 20 years or older
- 98. Don't know
- 99. Refused

181. What is the primary fuel source for heating?

- 1. Natural Gas
- 2. Electricity
- 3. Propane
- 97. Other (Specify): _____
- 98. Don't know
- 99. Refused

182. What is the temperature set-point of the heated space for heating?
[Record response in units indicated by the respondent]

- 1. Heating set-point Fahrenheit:
- 2. Heating set-point Celsius:
- 98. Don't know
- 99. Refused

183. What is the temperature set-point of the conditioned space for cooling?
[Record response in units indicated by the respondent]

- 1. Cooling set-point Fahrenheit:
- 2. Cooling set-point Celsius:
- 98. Don't know

99. Refused

[SHOW Q184 – Q194 IF Q163 = 3]

X. Ductless Mini Split

184. When did you install the ductless mini split? [If more than one piece of equipment installed, enter earliest date only]

185. What is the capacity of the ductless mini split? [Capture either in tons or in Btu/hr]

1. Tons:

2. Btu/hr:

98. Don't know

99. Refused

[IF Q185 = 1 OR 2, SKIP TO Q187]

186. How many square feet does the ductless mini split serve?

1. Square feet:

98. Don't know

99. Refused

187. What is the SEER of the ductless mini split?

1. SEER:

98. Don't know

99. Refused

[IF Q187 = 1, SKIP TO Q189]

188. What is the EER of the ductless mini split?

1. EER:

98. Don't know

99. Refused

189. Did the ductless mini split replace old equipment?

1. Yes

- 2. No
- 98. Don't know
- 99. Refused

[IF Q189 = 2, 98, OR 99, SKIP TO Q191]

190. How old was the replaced equipment?
- 1. 0 - 4 years
 - 2. 5 - 9 years
 - 3. 10 - 14 years
 - 4. 15 - 19 years
 - 5. 20 years or older
 - 98. Don't know
 - 99. Refused
191. What is the primary fuel source for heating?
- 1. Natural Gas
 - 2. Electricity
 - 3. Propane
 - 97. Other (Specify): _____
 - 98. Don't know
 - 99. Refused
192. What is the temperature set-point of the heated space for heating?
[Record response in units indicated by the respondent]
- 1. Heating set-point Fahrenheit:
 - 2. Heating set-point Celsius:
 - 98. Don't know
 - 99. Refused
193. What is the temperature set-point of the heated space for heating?
[Record response in units indicated by the respondent]
- 1. Heating set-point Fahrenheit:
 - 2. Heating set-point Celsius:
 - 98. Don't know

99. Refused

194. What is the temperature set-point of the conditioned space for cooling?
[Record response in units indicated by the respondent]

1. Cooling set-point Fahrenheit:

2. Cooling set-point Celsius:

98. Don't know

99. Refused

[SHOW Q195 – Q204 IF Q163 = 4]

Y. Air Source Heat Pump

195. When did you install the air source heat pump? [If more than one piece of equipment installed, enter earliest date only]

196. What is the capacity of the air source heat pump? [Capture either in tons or in Btu/hr]

1. Tons:

2. Btu/hr:

98. Don't know

99. Refused

[IF Q196 = 1 OR 2, SKIP TO Q198]

197. How many square feet does the air source heat pump serve?

1. Square feet:

98. Don't know

99. Refused

198. What is the SEER of the air source heat pump?

1. SEER:

98. Don't know

99. Refused

[IF Q198 = 1, SKIP TO Q200]

199. What is the EER of the air source heat pump?
- 1. EER:
 - 98. Don't know
 - 99. Refused
200. Did the air source heat pump replace old equipment?
- 1. Yes
 - 2. No
 - 98. Don't know
 - 99. Refused

[IF Q200 = 2, 98, OR 99, SKIP TO Q202]

201. How old was the replaced equipment?
- 1. 0 - 4 years
 - 2. 5 - 9 years
 - 3. 10 - 14 years
 - 4. 15 - 19 years
 - 5. 20 years or older
 - 98. Don't know
 - 99. Refused
202. What is the primary fuel source for heating?
- 1. Natural Gas
 - 2. Electricity
 - 3. Propane
 - 97. Other (Specify): _____
 - 98. Don't know
 - 99. Refused
203. What is the temperature set-point of the heated space for heating?
[Record response in units indicated by the respondent]
- 1. Heating set-point Fahrenheit:
 - 2. Heating set-point Celsius:
 - 98. Don't know

99. Refused

204. What is the temperature set-point of the conditioned space for cooling?
[Record response in units indicated by the respondent]

1. Cooling set-point Fahrenheit:

2. Cooling set-point Celsius:

98. Don't know

99. Refused

[SHOW Q205 – Q214 IF Q163 = 5]

Z. Geothermal/Ground Source Heat Pump

205. When did you install the ground source heat pump? [If more than one piece of equipment installed, enter earliest date only]

206. What is the capacity of the ground source heat pump? [Capture either in tons or in Btu/hr]

1. Tons:

2. Btu/hr:

98. Don't know

99. Refused

[IF Q207 = 1 OR 2, SKIP TO Q208]

207. How many square feet does the ground source heat pump serve?

1. Square feet:

98. Don't know

99. Refused

208. What is the SEER of the ground source heat pump?

1. SEER:

98. Don't know

99. Refused

[IF Q208 = 1, SKIP TO Q210]

209. What is the EER of the ground source heat pump?
- 1. EER:
 - 98. Don't know
 - 99. Refused
210. Did the ground source heat pump replace old equipment?
- 1. Yes
 - 2. No
 - 98. Don't know
 - 99. Refused

[IF Q210 = 2, 98, OR 99, SKIP TO Q212]

211. How old was the replaced equipment?
- 1. 0 - 4 years
 - 2. 5 - 9 years
 - 3. 10 - 14 years
 - 4. 15 - 19 years
 - 5. 20 years or older
 - 98. Don't know
 - 99. Refused
212. What is the primary fuel source for heating?
- 1. Natural Gas
 - 2. Electricity
 - 3. Propane
 - 97. Other (Specify): _____
 - 98. Don't know
 - 99. Refused
213. What is the temperature set-point of the heated space for heating?
[Record response in units indicated by the respondent]
- 1. Heating set-point Fahrenheit:
 - 2. Heating set-point Celsius:
 - 98. Don't know

99. Refused

214. What is the temperature set-point of the conditioned space for cooling?
[Record response in units indicated by the respondent]

1. Cooling set-point Fahrenheit:

2. Cooling set-point Celsius:

98. Don't know

99. Refused

[SHOW Q215 – Q223 IF Q163 = 6]

AA. Air-Cooled Chiller

215. When did you install the air-cooled chiller? [If more than one piece of equipment installed, enter earliest date only]

216. What is the capacity of the air-cooled chiller? [Capture either in tons or in Btu/hr]

1. Tons:

2. Btu/hr:

98. Don't know

99. Refused

[IF Q216 = 1 OR 2, SKIP TO Q218]

217. How many square feet does the air-cooled chiller serve?

1. Square feet:

98. Don't know

99. Refused

218. What is the efficiency of the new air-cooled chiller in kilowatts per ton?

1. Kilowatts per ton:

98. Don't know

99. Refused

219. Did the air-cooled chiller replace old equipment?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[IF Q219 = 2, 98, OR 99, SKIP TO Q221]

220. How old was the replaced equipment?

- 1. 0 - 4 years
- 2. 5 - 9 years
- 3. 10 - 14 years
- 4. 15 - 19 years
- 5. 20 years or older
- 98. Don't know
- 99. Refused

221. What is the primary fuel source for heating?

- 1. Natural Gas
- 2. Electricity
- 3. Propane
- 97. Other (Specify): _____
- 98. Don't know
- 99. Refused

222. What is the temperature set-point of the heated space for heating?

[Record response in units indicated by the respondent]

- 1. Heating set-point Fahrenheit:
- 2. Heating set-point Celsius:
- 98. Don't know
- 99. Refused

223. What is the temperature set-point of the conditioned space for cooling?

[Record response in units indicated by the respondent]

- 1. Cooling set-point Fahrenheit:
- 2. Cooling set-point Celsius:
- 98. Don't know
- 99. Refused

[SHOW Q224 – Q232 IF Q163 = 7]

BB. Water-Cooled Chiller

- 224. When did you install the water-cooled chiller? [If more than one piece of equipment installed, enter earliest date only]
- 225. What is the capacity of the water-cooled chiller? [Capture either in tons or in Btu/hr]
 - 1. Tons:
 - 2. Btu/hr:
 - 98. Don't know
 - 99. Refused

[IF Q225 = 1 OR 2, SKIP TO Q227]

- 226. How many square feet does the water-cooled chiller serve?
 - 1. Square feet:
 - 98. Don't know
 - 99. Refused
- 227. What is the efficiency of the new water-cooled chiller in kilowatts per ton?
 - 1. Kilowatts per ton:
 - 98. Don't know
 - 99. Refused
- 228. Did the water-cooled chiller replace old equipment?
 - 1. Yes
 - 2. No
 - 98. Don't know
 - 99. Refused

[IF Q228 = 2, 98, OR 99, SKIP TO Q230]

229. How old was the replaced equipment?

1. 0 - 4 years
2. 5 - 9 years
3. 10 - 14 years
4. 15 - 19 years
5. 20 years or older

98. Don't know

99. Refused

230. What is the primary fuel source for heating?

1. Natural Gas
2. Electricity
3. Propane

97. Other (Specify): _____

98. Don't know

99. Refused

231. What is the temperature set-point of the heated space for heating?

[Record response in units indicated by the respondent]

1. Heating set-point Fahrenheit:
2. Heating set-point Celsius:

98. Don't know

99. Refused

232. What is the temperature set-point of the conditioned space for cooling?

[Record response in units indicated by the respondent]

1. Cooling set-point Fahrenheit:
2. Cooling set-point Celsius:

98. Don't know

99. Refused

[SHOW Q233 – Q242 IF Q163 = 97]

CC. Other HVAC

233. When did you install the [Q163 Other (Specify)]? [If more than one piece of equipment installed, enter earliest date only]

234. What is the capacity of the [Q163 Other (Specify)]? [Capture either in tons or in Btu/hr]

1. Tons:

2. Btu/hr:

98. Don't know

99. Refused

[IF Q234 = 1 OR 2, SKIP TO Q236]

235. How many square feet does the [Q163 Other (Specify)] serve?

1. Square feet:

98. Don't know

99. Refused

236. What is the SEER of the [Q163 Other (Specify)]?

1. SEER:

98. Don't know

99. Refused

[IF Q236 = 1, SKIP TO Q237]

237. What is the EER of the [Q163 Other (Specify)]?

1. EER:

2. Not applicable

98. Don't know

99. Refused

238. Did the [Q163 Other (Specify)] replace old equipment?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q238 = 2, 98, OR 99, SKIP TO Q240]

239. How old was the replaced equipment?

1. 0 - 4 years

2. 5 - 9 years

3. 10 - 14 years

4. 15 - 19 years

5. 20 years or older

98. Don't know

99. Refused

240. What is the primary fuel source for heating?

1. Natural Gas

2. Electricity

3. Propane

97. Other (Specify): _____

98. Don't know

99. Refused

241. What is the temperature set-point of the heated space for heating?

[Record response in units indicated by the respondent]

1. Heating set-point Fahrenheit:

2. Heating set-point Celsius:

98. Don't know

99. Refused

242. What is the temperature set-point of the conditioned space for cooling?

[Record response in units indicated by the respondent]

1. Cooling set-point Fahrenheit:

2. Cooling set-point Celsius:

98. Don't know

99. Refused

[SHOW Q243 – Q178 IF Q10 = 3, SKIP TO LL]

DD. Refrigeration Verification

The next few questions will be about the refrigeration equipment that you installed or replaced.

243. What types of equipment did you install as part of the refrigeration project?
[Select all that apply]

1. ENERGY STAR certified Refrigerator
2. ENERGY STAR certified Freezer
3. Walk-in Cooler or Freezer
4. Refrigerated Display Case
5. ENERGY STAR certified Refrigerated Beverage Vending Machine
6. Automatic Commercial Ice Maker
7. Did not installed any refrigeration equipment
97. Other (Specify): _____
98. Don't know
99. Refused

[SHOW Q244 – Q248 IF Q243 = 1]

EE. ENERGY STAR certified Refrigerator

244. How many ENERGY STAR certified refrigerator(s) did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

245. When did you install the ENERGY STAR certified refrigerator(s)? [If more than one piece of equipment installed, enter earliest date only]

246. Using as much detail as possible, would you please describe the new equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:
2. Model:
3. Set-point Fahrenheit:
4. Set-point Celsius:

5. ENERGY STAR certified or standard efficiency?

97. Additional information:

98. Don't know

99. Refused

247. Did the ENERGY STAR certified refrigerator(s) replace old equipment?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q247 = 2, 98, OR 99, SKIP TO FF]

248. Using as much detail as possible, would you please describe the old equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:

2. Model:

3. Set-point Fahrenheit:

4. Set-point Celsius:

5. ENERGY STAR certified or standard efficiency?

97. Additional information:

98. Don't know

99. Refused

[SHOW Q249 – Q253 IF Q243 = 2]

FF.ENERGY STAR Certified Freezer

249. How many ENERGY STAR certified freezer(s) did you install?

[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

250. When did you install the ENERGY STAR certified freezer(s)? [If more than one piece of equipment installed, enter earliest date only]

251. Using as much detail as possible, would you please describe the new equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:
2. Model:
3. Set-point Fahrenheit:
4. Set-point Celsius:
5. ENERGY STAR certified or standard efficiency?
97. Additional information:
98. Don't know
99. Refused

252. Did the ENERGY STAR certified freezer(s) replace old equipment?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q252 = 2, 98, OR 99, SKIP TO GG]

253. Using as much detail as possible, would you please describe the old equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:
2. Model:
3. Set-point Fahrenheit:
4. Set-point Celsius:
5. ENERGY STAR certified or standard efficiency?
97. Additional information:
98. Don't know
99. Refused

[SHOW Q254 – Q258 IF Q243 = 3]

GG. Walk-in Cooler or Freezer

254. How many walk-in cooler(s) or freezer(s) did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]
255. When did you install the walk-in cooler(s) or freezer(s)? [If more than one piece of equipment installed, enter earliest date only]
256. Using as much detail as possible, would you please describe the new equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?
1. Make:
 2. Model:
 3. Set-point Fahrenheit:
 4. Set-point Celsius:
 5. ENERGY STAR certified or standard efficiency?
97. Additional information:
98. Don't know
99. Refused
257. Did the walk-in cooler(s) or freezer(s) replace old equipment?
1. Yes
 2. No
98. Don't know
99. Refused

[IF Q257 = 2, 98, OR 99, SKIP TO HH]

258. Using as much detail as possible, would you please describe the old equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?
1. Make:
 2. Model:
 3. Set-point Fahrenheit:
 4. Set-point Celsius:

5. ENERGY STAR certified or standard efficiency?

97. Additional information:

98. Don't know

99. Refused

[SHOW Q259 – Q263 IF Q243 = 4]

HH. Refrigerated Display Case

259. How many refrigerated display case(s) did you install?

[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

260. When did you install the refrigerated display case(s)? [If more than one piece of equipment installed, enter earliest date only]

261. Using as much detail as possible, would you please describe the new equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:

2. Model:

3. Set-point Fahrenheit:

4. Set-point Celsius:

5. ENERGY STAR certified or standard efficiency?

97. Additional information:

98. Don't know

99. Refused

262. Did the refrigerated display case(s) replace old equipment?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q262 = 2, 98, OR 99, SKIP TO II]

263. Using as much detail as possible, would you please describe the old equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:
2. Model:
3. Set-point Fahrenheit:
4. Set-point Celsius:
5. ENERGY STAR certified or standard efficiency?
97. Additional information:
98. Don't know
99. Refused

[SHOW Q264 – Q268 IF Q243 = 5]

II. ENERGY STAR certified Refrigerated Beverage Vending Machine

264. How many ENERGY STAR certified refrigerated beverage vending machine(s) did you install?

[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

265. When did you install the ENERGY STAR certified refrigerated vending machine(s)? [If more than one piece of equipment installed, enter earliest date only]

266. Using as much detail as possible, would you please describe the new equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:
2. Model:
3. Set-point Fahrenheit:
4. Set-point Celsius:
5. ENERGY STAR certified or standard efficiency?
6. Standard efficiency
97. Additional information:
98. Don't know
99. Refused

267. Did the refrigerated beverage vending machine(s) replace old equipment?
1. Yes
 2. No
 98. Don't know
 99. Refused

[IF Q267 = 2, 98, OR 99, SKIP TO JJ]

268. Using as much detail as possible, would you please describe the old equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?
1. Make:
 2. Model:
 3. Set-point Fahrenheit:
 4. Set-point Celsius:
 5. ENERGY STAR certified or standard efficiency?
 6. Standard efficiency
 97. Additional information:
 98. Don't know
 99. Refused

[SHOW Q269 – Q273 IF Q243 = 6]

JJ. Automatic Commercial Ice Maker

269. How many automatic commercial ice maker(s) did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]
270. When did you install the automatic ice maker(s)? [If more than one piece of equipment installed, enter earliest date only]
271. Using as much detail as possible, would you please describe the new equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?
1. Make:
 2. Model:
 3. Set-point Fahrenheit:

- 4. Set-point Celsius:
 - 5. ENERGY STAR certified or standard efficiency?
 - 97. Additional information:
 - 98. Don't know
 - 99. Refused
272. Did the automatic commercial ice maker(s) replace old equipment?
- 1. Yes
 - 2. No
 - 98. Don't know
 - 99. Refused

[IF Q272 = 2, 98, OR 99, SKIP TO KK]

273. Using as much detail as possible, would you please describe the old equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?
- 1. Make:
 - 2. Model:
 - 3. Set-point Fahrenheit:
 - 4. Set-point Celsius:
 - 5. ENERGY STAR certified or standard efficiency?
 - 97. Additional information:
 - 98. Don't know
 - 99. Refused

[SHOW Q274 – Q278 IF Q243 = 97]

KK. Other Refrigeration Measure

274. How many [Q243 Other (Specify)] did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]
275. When did you install the [Q243 Other (Specify)]? [If more than one piece of equipment installed, enter earliest date only]

276. Using as much detail as possible, would you please describe the new equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:
2. Model:
3. Set-point Fahrenheit:
4. Set-point Celsius:
5. ENERGY STAR certified or standard efficiency?
97. Additional information:
98. Don't know
99. Refused

277. Did the [Q243 Other (Specify)] replace old equipment?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q277 = 2, 98, OR 99, SKIP TO LL]

278. Using as much detail as possible, would you please describe the old equipment, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

1. Make:
2. Model:
3. Set-point Fahrenheit:
4. Set-point Celsius:
5. ENERGY STAR certified or standard efficiency?
97. Additional information:
98. Don't know
99. Refused

[SHOW Q279 – Q294 IF Q10 = 4, SKIP TO PP]

LL. Clothes Washer and Other Appliance Verification

The next few questions will be about the clothes washers and other appliances that you installed or replaced.

279. Indicate which of the following clothes washers, or other appliances that you have installed? [Select all that apply]

- 1. Clothes Washer:
- 2. Other Appliance 1 (Specify):
- 3. Other Appliance 2 (Specify):
- 98. Don't know
- 99. Refused

[SHOW Q280 – Q284 IF Q279 = 1]

MM. Clothes Washers

280. How many clothes washer(s) did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

281. When did you install the clothes washer(s)? [If more than one piece of equipment installed, enter earliest date only]

282. Did the new clothes washer replace an old clothes washer?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[IF Q282 = 2, 98, OR 99, SKIP TO NN]

283. How old was the existing clothes washer?

- 1. 0-4 years
- 2. 5-9 years
- 3. 10-14 years
- 4. 15-19 years

5. 20 years or older

98. Don't know

99. Refused

284. Was the existing clothes washer rated as energy efficient (e.g. was it ENERGY STAR certified equipment)?

1. Yes

2. No

98. Don't know

99. Refused

[SHOW Q285 – Q289 IF Q279 = 2]

NN. Other Appliances 1

285. How many [Q279 Other Appliance 1 (Specify)] did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

286. When did you install the [Q279 Other Appliance 1 (Specify)]? [If more than one piece of equipment installed, enter earliest date only]

287. Did the new [Q279 Other Appliance 1 (Specify)] replace an old [Q279 Other Appliance 1 (Specify)]?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q287= 2, 98, OR 99, SKIP TO 00]

288. How old was the existing [Q279 Other Appliance 1 (Specify)]?

1. 0-4 years

2. 5-9 years

3. 10-14 years

4. 15-19 years

5. 20 years or older

98. Don't know

99. Refused

289. Was the existing [Q279 Other Appliance 1 (Specify)] rated as energy efficient (e.g. was it ENERGY STAR certified equipment)?

1. Yes

2. No

98. Don't know

99. Refused

[SHOW Q290 – Q294 IF Q279 = 3]

OO. Other Appliances 2

290. How many [Q279 Other Appliance 2 (Specify)] did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

291. When did you install the [Q279 Other Appliance 2 (Specify)]? [If more than one piece of equipment installed, enter earliest date only]

292. Did the new [Q279 Other Appliance 2 (Specify)] replace an old [Q279 Other Appliance 2 (Specify)]?

1. Yes

2. No

98. Don't know

99. Refused

[IF Q292 = 2, 98, OR 99, SKIP TO PP]

293. How old was the existing [Q279 Other Appliance 2 (Specify)]?

1. 0-4 years

2. 5-9 years

3. 10-14 years

4. 15-19 years

5. 20 years or older

98. Don't know

99. Refused

294. Was the existing [Q279 Other Appliance 2 (Specify)] rated as energy efficient (e.g. was it ENERGY STAR certified equipment)?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[SHOW Q295 – Q309 IF Q10 = 5, SKIP TO SS]

PP. Motor Verification

The next few questions will be about the motors that you installed or replaced.

295. What changes did you make to your electric motors? Did you... [Read options; Select all that apply]

- 1. Install or replace a motor
- 2. Install Variable Frequency Drives (VFDs) on existing motors
- 97. Did something else (Specify):
- 98. Don't know **[DO NOT READ]**
- 99. Refused **[DO NOT READ]**

[SHOW Q296 – Q304 IF Q295 = 1]

QQ. Motors

296. How many motor(s) did you install?

[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

297. When did you install the motor(s)? [If more than one piece of equipment installed, enter earliest date only]

298. What is the approximate average horsepower of the new motors? [IF NEEDED: "We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [UTILITY]"]

[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

299. What is the approximate average efficiency of the new motors? [IF NEEDED: "We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [UTILITY]"]

[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

300. On average, how many hours per day do the new motors operate? [IF NEEDED: "We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [UTILITY]"]
[NUMERIC OPEN END: 1-24; 98 = DON'T KNOW; 99 = REFUSED]

301. Did the motors replace existing motors? [IF NEEDED: "We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [UTILITY]"]

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

[IF Q301 = 2, 98, OR 99, SKIP TO RR]

302. Approximately how old were the motors that were replaced? [IF NEEDED: "We are interested in the average across all of the motors were replaced"]

- 1. 0-4 years
- 2. 5-9 years
- 3. 10-14 years
- 4. 15-19 years
- 5. 20 years or older
- 98. Don't know
- 99. Refused

303. What is the approximate average horsepower of the motors that were replaced? [IF NEEDED: "We are interested in the average across all of the motors were replaced"]
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

304. What is the approximate average efficiency of the motors that were replaced? [IF NEEDED: "We are interested in the average across all of the motors were replaced"]
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

[SHOW Q305 – Q309 IF Q295 = 2]

RR. Variable Frequency Drives (VFDs)

305. How many motors did you install VFDs on?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]
306. When did you install the VFDs? [If more than one piece of equipment installed, enter earliest date only]
307. What is the approximate average horsepower of the motors you installed VFDs on? [IF NEEDED: "We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [UTILITY]"]
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]
308. On average, how many hours per day do the motors with VFDs operate?
[IF NEEDED: "We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [UTILITY]"]
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]
309. What application are these VFD motors used for?
1. Heating or cooling
 2. Some other process (Specify): _____
 98. Don't know
 99. Refused

[SHOW Q310 – Q312 IF Q10 = 97, SKIP TO TT]

SS. Other Equipment

The next few questions will be about the other equipment that you installed or replaced.

310. What other type of equipment did you install?
1. Other Equipment (Specify): _____
 98. Don't know
 99. Refused
311. When did you install the [Q310 Other Equipment (Specify)]? [If more than one piece of equipment installed, enter earliest date only]
312. How many [Q310 Other Equipment (Specify)](s) did you install?
[NUMERIC OPEN END: 1-500; 998 = DON'T KNOW; 999 = REFUSED]

TT. Contact Information

Thank you for your time in answering the questions on this survey. You will be contacted shortly for follow-up information and to possibly schedule an in-person visit.

313. Would you please provide us with your full name, an email address, and phone number to follow-up with?

1. Full name:
2. Email address:
3. Telephone number:

If you have any questions regarding this market study, you can reach us at (775) 229-4430.

UU. Thank You

Thank you for your time today and have a wonderful day!

7 Appendix C: Additional Documentation

7.1 C&I Commitment Payment Letter

[DATE]

Dear [NAME],

Thank you for participating in the Customer Action Program, a market research study conducted by ADM Associates, Inc. on behalf of FirstEnergy's Ohio utilities. We appreciate you taking the time to provide us with information about the energy-efficient measures you installed in 2018. Enclosed is the payment that was promised based on annual kWh savings from installations you made in 2018.

If you have any questions or concerns, please feel free to contact me.

Sincerely,

Cody Dawson

ADM Associates

330-239-8677

cody.dawson@admenergy.com